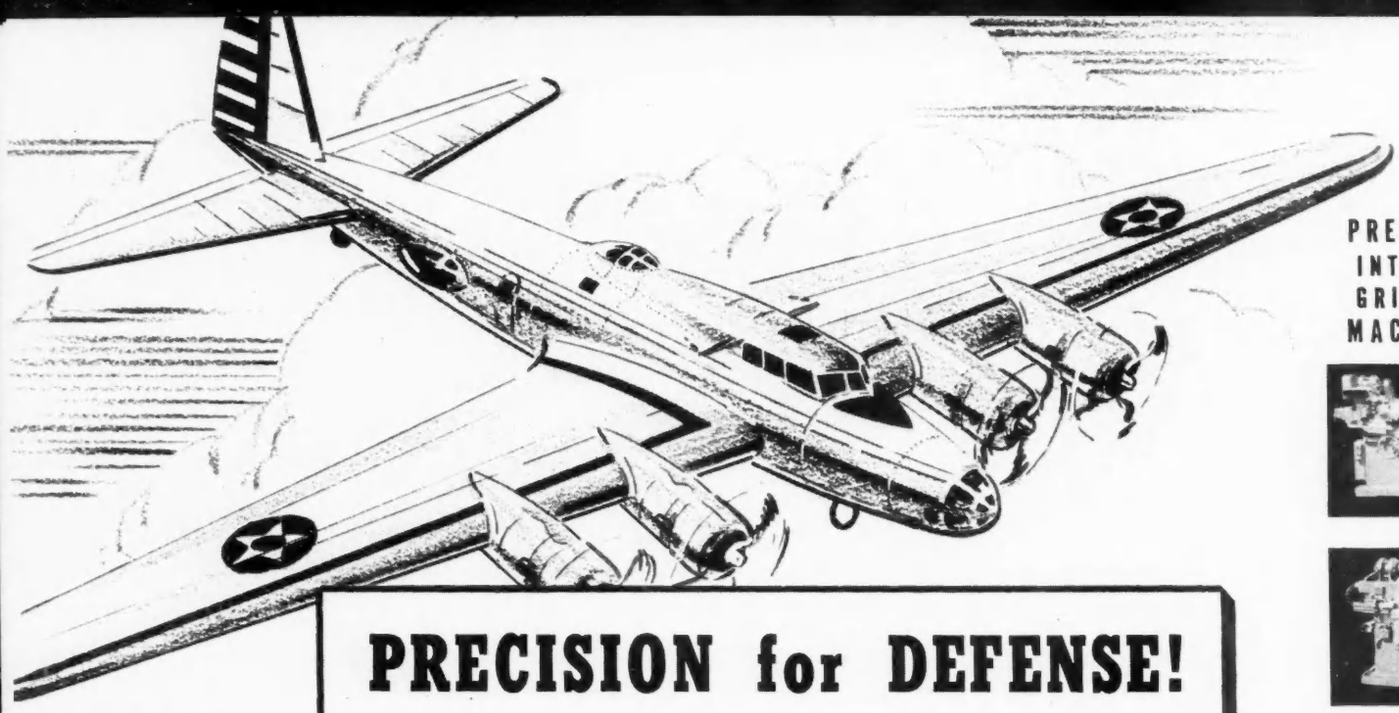
# AUTOMOTIVE INDUSTRIES

LAND — AIR — WATER



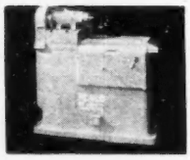
JULY 15, 1940

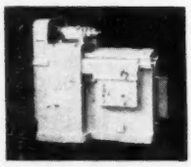


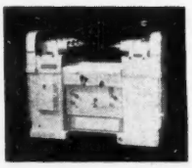


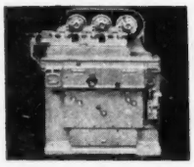
# PRECISION for DEFENSE!

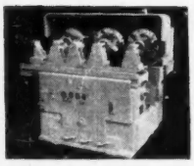
PRECISION
BORING
FACING
TURNING
MACHINES



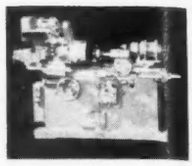


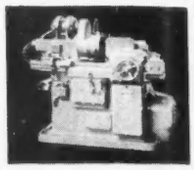


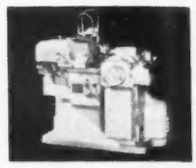


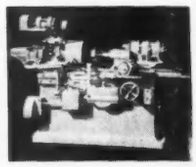


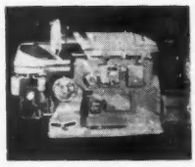
PRECISION
INTERNAL
GRINDING
MACHINES

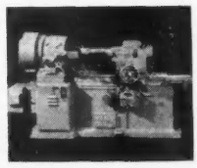


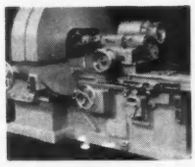












No other factor is more vital to a successful national defense program than precision in manufacturing. On precision hinges the performance of practically every unit of defense including such components as gun sights, gyroscopic compasses, rifle mechanisms, instruments, airplane propellers, and all kinds of other devices — some brutes of strength, some extremely delicate and sensitive, but all requiring precision.

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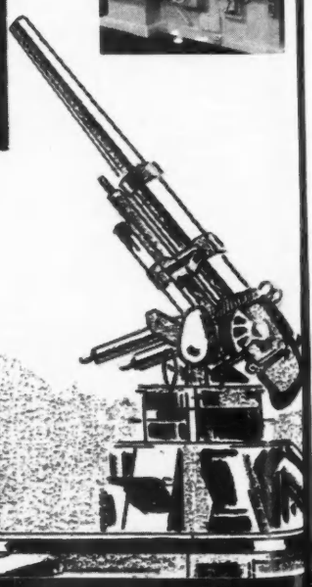

# AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 83 Number 2




## CONTENTS






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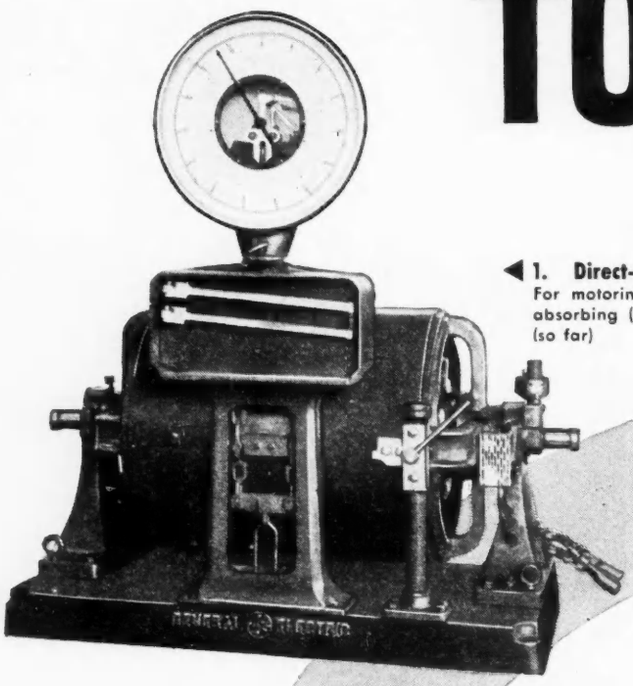
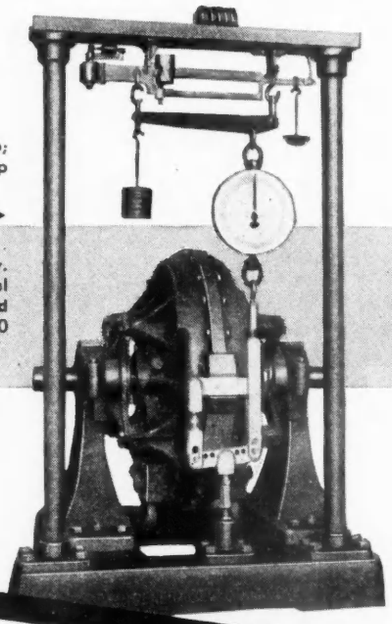
# TO BE SURE

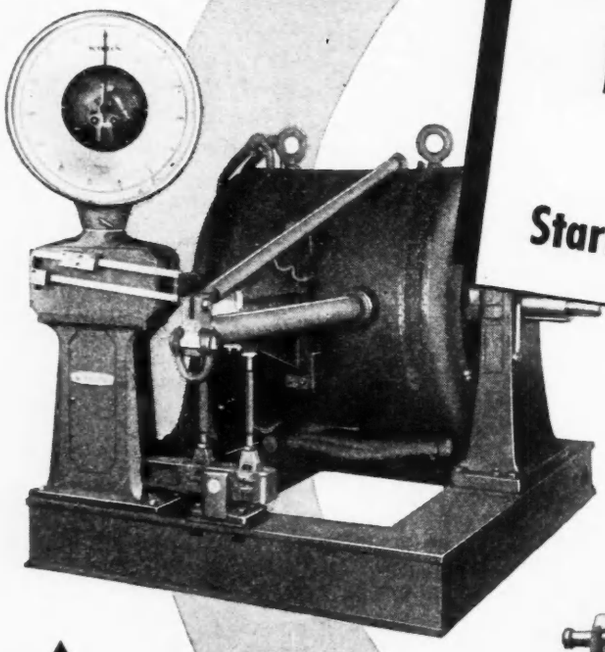


◀ **1. Direct-Current Electric**
For motoring (driving) up to 500 hp; absorbing (load testing) up to 700 hp (so far)

▶ **2. Hydraulic**
For absorbing duty only. Horsepower proportional to cube of speed. Applied to measure up to 3000 hp (so far)



## DYNAMOMETERS
### FOR EVERY PURPOSE
### Starting Up · Running In · Load Testing



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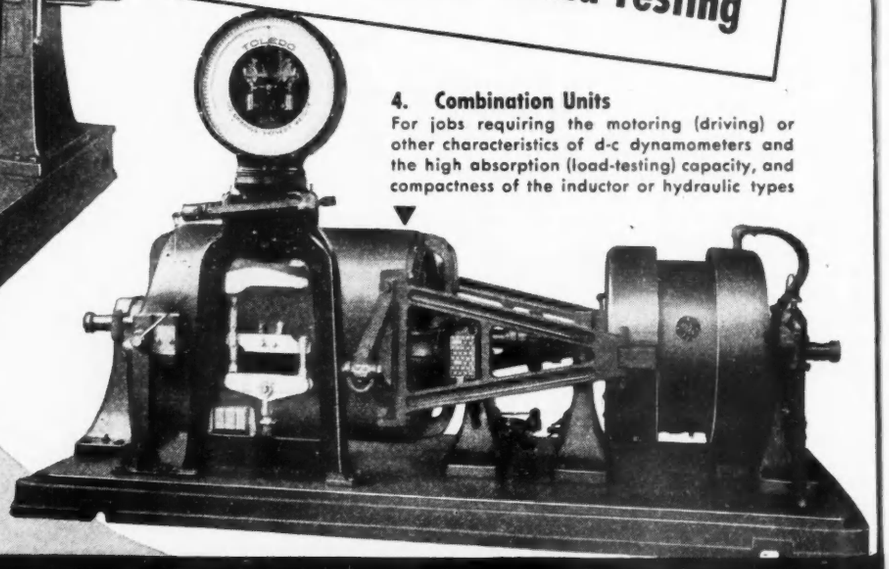
Most compact type and highest horsepower capacity, for absorbing duty (load testing) only; up to 4000 hp (so far)



**4. Combination Units**
For jobs requiring the motoring (driving) or other characteristics of d-c dynamometers and the high absorption (load-testing) capacity, and compactness of the inductor or hydraulic types ▼

**GENERAL ELECTRIC**

# IN THIS ISSUE . . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 83 July 15, 1940 Number 2

WHEN the parking-brake lever was removed from the center of the front compartment to the driver's left, under the cowl, some years ago, the change was not an all-around improvement. The chief object, that of clearing the front compartment of obstructions and making it easier to get in and out, was fully accomplished, but the brake, in many cases at least, was not as effective as it had been previously, when the operating lever was mounted on the transmission housing. When operated by an under-cowl lever, the parking brake frequently cannot be set sufficiently tight so it will hold the car on a grade of any importance, and it is widely being recommended to put the transmission in gear when leaving the car on a grade. Besides, the holding power of the emergency brake when set normally is so low that if the driver forgets to unlock it when starting off, he may not notice the difference in the drag on the car and run a long distance before he discovers that his brake is still set. In that case, even though there may be only light pressure of the brake shoes against the drum, there must be considerable wear and heating of the linings, and a corresponding loss in power.

There are probably two reasons why parking brakes do not hold as well when controlled by an under-cowl lever as when set by a floor-mounted lever. In the first place, there is less room under the cowl, and the lever therefore must be made shorter. Besides, the hook-up of the lever with the brakes naturally is more complicated and requires a greater number of levers and brackets, some of them at points where it may be difficult to obtain a rigid mounting. This probably makes it necessary to keep down the multiplication of the brake linkage, as with a high multiplication the "reserve" of brake lever motion would be taken up very rapidly.

Whatever the exact cause of the inadequate holding power of these parking brakes, it would certainly be well for engineering departments to examine their designs with a view to increasing the holding power of their parking brakes, if that can be accomplished without introducing other disadvantageous features.



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AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

Vol. 83, No. 2
July 15, 1940

# Selective Training

## *Military and Industrial*

***Both kinds are dependent on volunteering at the present time. Some order must be established for the future.***

By HERBERT HOSKING

TRAINING of skilled workers for the manufacture of munitions, and that means everything required by an army or navy, or even by a whole nation engaged in a total war, is a problem to which hundreds of scattered sources are giving attention, without much integrated direction. The automotive industry has been a leader in providing intramural training for its own workers, and even for their sons and relatives. Other industries have done a good deal of the same kind of training, and still others have preferred to work out plans in conjunction with the vocational training facilities of the communities in which they are established.

Generally speaking, in tapping sources for converting men into skilled workers, you take what you get, where you are. In vocations where there is an acute shortage of skills, wages rise, and there is a certain tendency for workers to become interested in being trained for jobs in which the rate of pay is higher. Adjustments between localities and between skill groups in which there are shortages or plethoras, are slow and cumbersome, particularly in time of emergency.

Intimately linked with the problem of training skilled industrial workers is the problem of training an army. If you train too many people at once for an army, you are likely to rob the reservoir of skilled workers, unless some system is adopted for selecting the personnel of your army. If you wait for your army to volunteer for service, you will get an army eventually, but it may not be trained in time for use.

Some of the problems of this kind, which face us now, could probably be met best by the enactment of a selective training and service bill, covering the military services. This might be supplemented with an industrial training coordinating measure, so that between the two, everyone of use to industry or to the military services would have a general idea of what he was expected to do for the nation in time of emergency.

There is before Congress at the present time a selective training and service bill which would provide for the registration of all male citizens between the ages of 18 and 65 years. For a portion of this group, the bill would provide peace time military training of eight months out of a single year, to be followed by supplementary training.

The present bill (introduced by Senator Burke and Representative Wadsworth) would exempt from military training such men as were found by local selection boards to be necessary in industry or agriculture. The bill is very broad in its aspects and makes a good many of its provisions discretionary.

There are so many problems involved in the technique of establishing and implementing a selective service law, that no nation with as little experience in the subject as the United States is likely to evolve one that is perfect overnight. It does seem, however, that such a law is indicated as the fairest way of choosing those who shall be trained for combat service if needed; of protecting the interests of industry against those of the military services; and assuring the military services of the kind and number of men they need, and providing them for training at a time when they can be trained adequately.

It seems to us, therefore, that industry should take an interest in a selective service bill.

Industry is facing pretty squarely the problems of adapting the machinery and management of production to the requirements of national defense. It is certainly time to give thought to the problem of the equitable distribution of manpower which will be a big problem soon.

# Inter-Office Communication

By EDWARD L. WARNER, JR.

NERVE center of any large automobile manufacturing company is its communications system, which coordinates its manufacturing, distribution and sales activities throughout the nation. Production must be regulated, parts and material must be ordered, sales must be recorded, and shipments must be routed to arrive at the proper time and the proper place.

In order to expedite this large volume of message traffic, the bigger corporations in the automobile industry operate their own inter-plant communication systems. During the last eight years, the teletypewriter has come into general use in the industry. This machine permits an operator to type out a message on a regulation keyboard that is received instantaneously on a similar machine, which may be located several thousand miles distant from the sending point, or in the same city only a few blocks away.

Hudson Motor Car Company was the first automobile manufacturer to use private teletypewriter service, connecting up 22 stations in its manufacturing and body plants at Detroit in 1927 in order to coordinate manufacturing and assembly operations. In addition, private line service is maintained between Detroit and the Canadian plant at Tilbury, Ont.

Ford, Chevrolet and Chrysler were among the first automobile concerns to employ inter-city teletype service on an extensive scale, installing TWX (Teletypewriter Exchange Service) stations as early as 1932. Packard, Nash and International Harvester Company are other automotive users of inter-plant communications systems.

General Motors Corporation, with its vast manufacturing and distribution operations, began the corporation-wide use of teletype on May 1, 1939, although the General Motors Parts Corporation by that time had 45 cities connected by teletype for coordinating its parts distribution system. Chevrolet Motor Division of General Motors Sales Corporation also has used teletype extensively for several years between its sales outlets. Buick, United Motors Service, Delco Products, Inland and Harrison Radiator divisions also had employed the service to a limited extent.

General Motors felt that coordination of its divisional communication activities would provide faster and more economical service when it began a study of an inter-plant communication system in 1937. The corporation believed that centralization of its communition facilities would result in marked efficiency as well as increased speed through the use of common chan-

***Telephone operators at the New York office of General Motors receive outgoing messages to be transmitted to other cities by teletype.***

# Systems

## *facilitate industry's Operations*

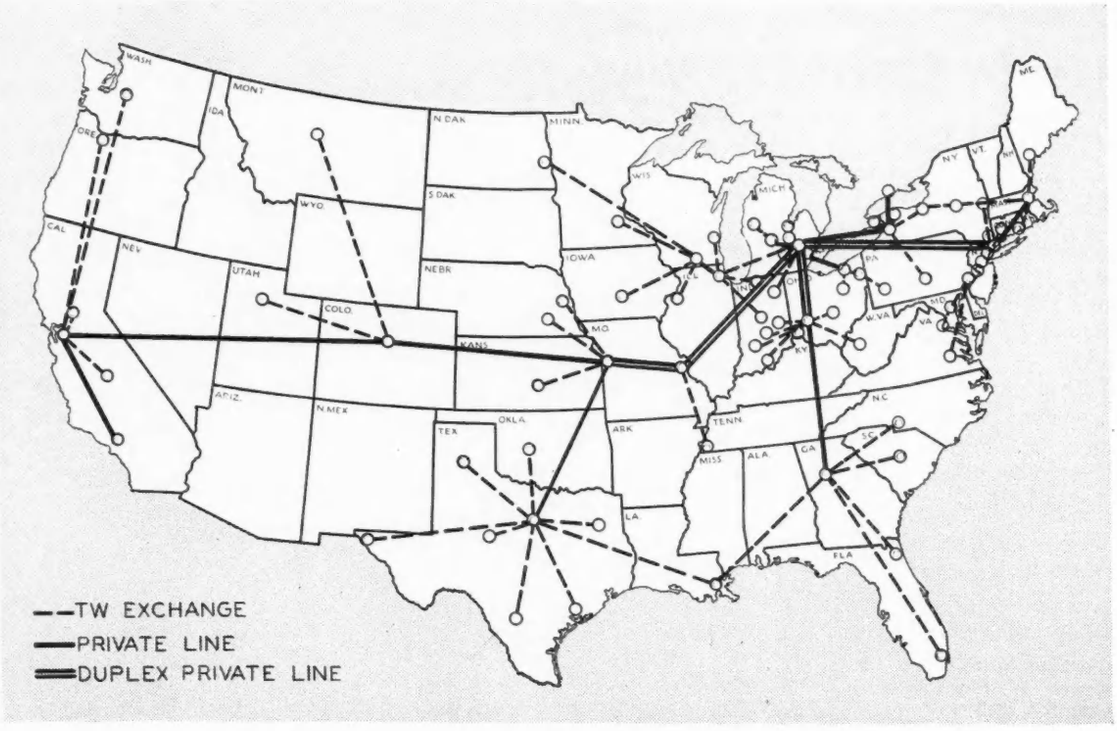
nels. Previously, each division of General Motors had handled its own inter-city traffic, some by telephone, others by telegraph and a few by teletype.

After a two-year study in cooperation with communications experts, the corporation formed a Communications Section, headed by Donald D.

***Supervisor and operator in the teletype department of the Chrysler Corp. on the job at Detroit.***

***Telegraph department of the Ford Motor Co. in the Administration building at Dearborn.***

# General Motors Communication Lines




Dayton
Muncie
Anderson
Indianapolis
Columbus
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Louisville
Atlanta
Charlotte
Columbia
Birmingham
Jamestown
Miama
New Orleans
St. Louis
Memphis
Chicago
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Kokomo
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Cleveland
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Akron
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Buffalo
Tonawanda
Lockport

Oshawa
Rochester
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Albany
Portland, Me.

Boston
Meriden
Bistol
New York
Tarrytown

Bloomfield
Linden
Harrison
Trenton
Philadelphia

Baltimore
Washington
Richmond
Toledo
Fort Wayne

Hogate, with William J. Franks as his assistant.

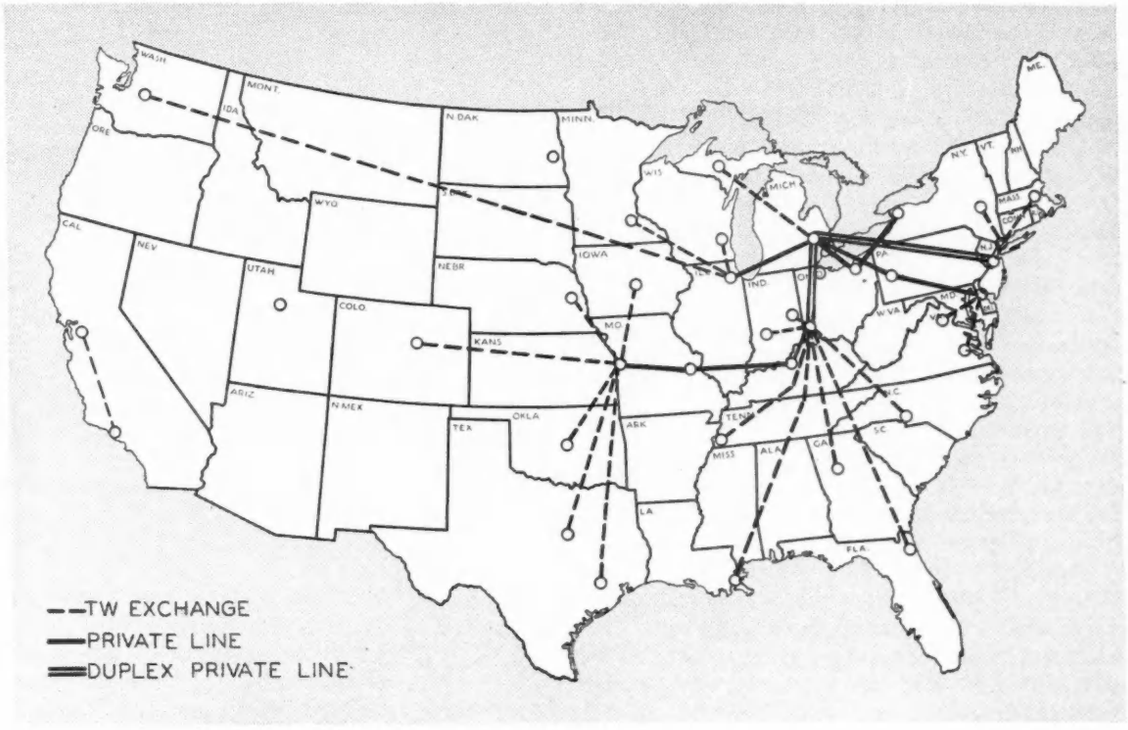
The system has grown steadily until it now embraces 28 cities, and it is expanding every week as a study of message volume warrants the addition of more points. At present, it is only one-third completed, but eventually it will connect more than 500 General Motors plants, offices and warehouses in 88 cities, which will make it the largest privately operated communication system in the world. It will be completed in approximately two years and then will employ more than 240 operators, message delivery and pick-up girls.

The Communications Section has its headquarters at the General Motors Building in midtown Detroit. From that point, the network radiates to all sections of the country. Eight private lines connect the Detroit office with New York, Philadelphia, Dayton, Chicago, Flint, Pontiac, Lansing and Grand Rapids. Two of these, with New York and Flint, are duplex wires that permit simultaneous transmission of messages in both directions. There also are connections with Atlanta, St. Louis, Pittsburgh, Baltimore, Trenton, N. J.,

***Teletype operators in the central communication section of General Motors Corp. in Detroit.***

# Ford Motors Communication Lines

Dearborn
Edgewater
New York
Somerville
Green Island
Toledo
Cleveland
Buffalo
Pittsburgh
Chester
Norfolk
Alexandria
Cincinnati
Hamilton
Indianapolis
Memphis
Charlotte
Atlanta
New Orleans
Jacksonville
Louisville
St. Louis
Kansas City
Des Moines
Omaha
Denver
Oklahoma City
Dallas
Houston
Chicago
Milwaukee
Iron Mt
Twin City
Seattle
Richmond, Cal.
Long Beach




Janesville, Wis., Milwaukee, and Kokomo, Ind., through intermediate relay points. In addition, there is a leased wire between Dayton, and three Indiana points —Indianapolis, Anderson and Muncie—which provides a "feeder" channel from the Indiana plants to the Dayton relay point. Ionia, Mich., is connected by telephone from Grand Rapids, and the Electro-Motive plant at LaGrange, Ill., by telephone from Chicago.

There also are TWX machines at Detroit that permit instantaneous and direct communication with any other TWX station in the country, either within or outside the corporation network. However, most of the message traffic is routed into Detroit over the leased teletype wires. The cities not connected with Detroit by private teletype wire send their messages to the nearest private wire point, where they are relayed to Detroit. These are TWX feeder channels and each such station has a frequent schedule which it follows in transmitting its messages to other points.

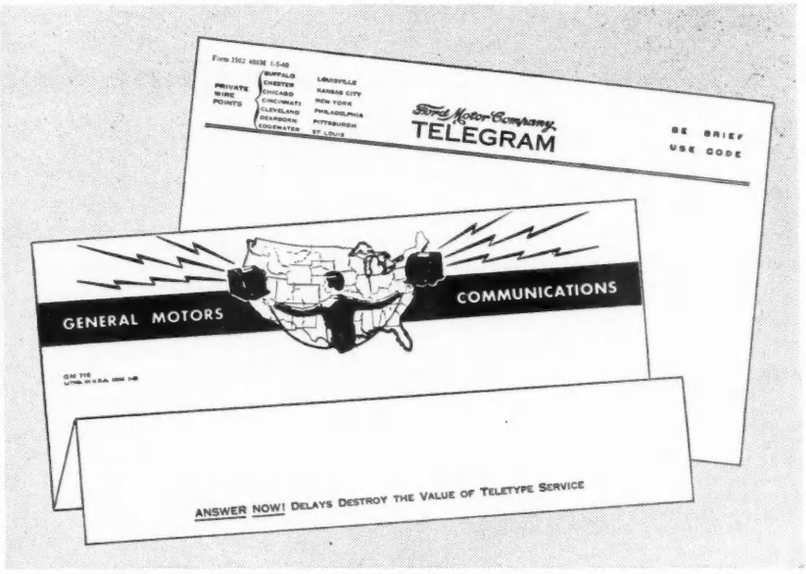
As an illustration, the General Motors teletype station at Atlanta may have messages destined for Detroit or any of the other 26 cities on the present system. The messages are put on the teletype and sent to Dayton. At Dayton the incoming messages arrive on an automatic reperforator and are relayed to their destinations over leased teletype wires by running the perforated tape through an automatic transmitter. No retyping is required at

***New car delivery orders of the Ford Motor Co. are sent from the Administration Building in Dearborn to the New Car Delivery building by teletype. Here an order has just been received.***

the relaying point. The perforated tape conveys the message exactly as it was originally transmitted. Clearing messages from the South through Dayton saves materially in wire tolls because the leased teletype wire from Dayton to Detroit is more economical for a heavy volume of traffic than sending the messages individually from Atlanta to the points of destination. Similarly, messages from Tarryton, N. Y., and Linden and Bloomfield, N. J., are cleared over the leased teletype wire to New York City and then relayed to their destination.

As the General Motors system expands, more cities will be embraced, additional teletypewriter points will be established and more lease teletype wires installed.

The wire room at Detroit has 13 employes and 10 teletype machines. The operators are thoroughly trained in teletypewriter operation and have a detailed knowledge of General Motors operations before they are entrusted with the responsibility of handling communications. They are selected for their accuracy, courtesy and ability, and most of them have had previous service with communications companies. Accuracy and speed are essential but accuracy comes first.




***Message forms used by the Ford and General Motors organizations.***

The central office is open from 7.30 A.M. to 6 P.M., five days a week. Most outgoing messages are received by telephone from General Motors plants and offices in various parts of Detroit by four typists equipped with telephone headsets. They type the messages, read them back to the senders for accuracy, then pass them to the teletype operators. All messages are numbered so that any mislaid message will be known immediately by an "omit" (omitted number) at the destination point.

The operators do not have to be in direct contact with the point of destination before typing out a message. They can punch it out on the automatic tape while the inter-city circuit is used for incoming messages. When sending, the perforated tape runs through the automatic transmitter at the rate of 360 characters, or approximately 60 words, a minute.

Upon receipt, messages are time-stamped, mounted upon a standard General Motors communications form and dispatched by messenger or telephone to their destination. At present, about 80 per cent of the messages have to do with manufacturing operations, but eventually when more sales points are connected with the network, it is expected that the sales message traffic will increase. Present volume is about 45,000 messages per month.

Ford Motor Company at the present time has an extensive inter-plant communication system, with stations in 36 branches. Since the early days of the company, Ford has maintained a private wire system which now totals 2258 miles of leased wire, 729 miles of which is duplexed, and 30 miles of its own intra-plant wire. Six TWX stations in as many branches started the transformation to teletype in 1932, and the change was completed Feb. 19, 1940, when the Morse system was completely displaced.

The Ford system has 12 points served by private line teletype service. Three of these, namely, Cincinnati, New York, and Edgewater, N. J., are connected by duplexed wires with Dearborn, and these may handle as many as 2000 messages per circuit per day. Other private wire points are Chicago, Cleveland, Buffalo, Pittsburgh, Chester, Pa., St. Louis and Kansas City. There also is TWX service with 24 other plants and branches, such as the Ford plant at Iron Mountain, Mich., and sales branches at Seattle, Denver, New Orleans and Jacksonville, Fla.

Ford relays its messages to and from distant TWX points through its private wire teletype relay points. Thus, messages from Ford points in the Southwest are transmitted over TWX feeder lines to the private line relay point at Kansas City, those from southeastern points through Cincinnati, from eastern cities through New York and from the West and Northwest through Chicago.

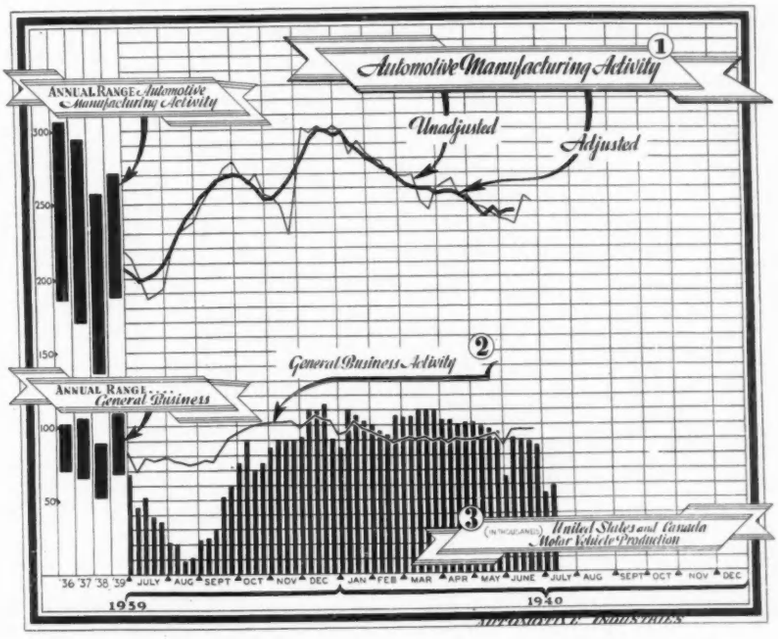
Bulk of the messages, which may total 5500 per day, are concerned with manufacturing, as Ford has 16 assembly plants spread out across the country. There also is considerable sales message traffic and export business with Edgewater, N. J., and Chester, Pa. All cables are cleared through the New York office except those for the Far East, which go via San Francisco. Communication with the Ford rubber plantation at Boa Vista, Brazil, is maintained by commercial cables from New York to Para, Brazil, and thence by radio to the plantation far up the Amazon River valley. Boa Vista is south of the Amazon on the Tapajoz River.

The central communications department in the Administration Building at Dearborn is the focal point through which all Detroit messages clear. Delivery of messages in the Detroit area outside of the Administration Building is accomplished by an inter-plant

(*Turn to page* **92**, *please*)

# BUSINESS IN BRIEF

***Our own view of automotive production and sales: authoritative interpretation of general conditions***




***Weekly indexes of automotive general business charted***

# Output Declines Toward Low Point

PRODUCTION of motor cars and trucks showed the usual seasonal decline toward the low point of the year during the first half of July. Only four of the big manufacturers still were in production the second week of July as many plants closed down for the annual changeover to 1941 models after the July Fourth holiday. The first 1941 model production is anticipated early in August. Several companies were unable to fill all their 1940 model orders due to shortage of material and will have backlogs as high as 3000 cars waiting for 1941 production.

The July Fourth holiday on Thursday cut two days off the working week ending July 6, accounting for production of approximately 53,500 vehicles during that period. General Motors turned out 24,700 units, while Ford manufactured 12,800 motor cars and trucks and Chrysler output was 12,600 vehicles. Graham and Willys were the only independent manufacturers in production, all the others having started retooling in preparation for 1941 models.

Output for the week ending July 13 was estimated at 63,000 units. July's production will be the lowest of 1940 and may not much exceed the total of 218,478 units turned out in July, 1939. This contrasts with a total of 348,900 vehicles produced in June, according to A. M. A. estimate.

June retail sales exceeded the expectations of many factory executives, especially for the last 10 days of the month. Customer anticipation of higher retail prices on 1941 models and the increase in the Federal excise tax from 3 to 3½ per cent July 1 probably accounted for some of the late June buying.

General Motors' June sales of 173,212 motor cars and trucks were the third highest for that month on record, being exceeded only in 1928 and 1936. The June total was 39 per cent above June, 1939, and 4.5 per cent ahead of May, the first time in recent years that GM June retail sales have surpassed May. GM factory sales to dealers in the first six months of 1940 were 1,013,034 units, the largest for that period.

Chevrolet's combined new and used car retail sales for June were 317,405 units, highest for any month in the division's history, while the new car sales were 35.6 per cent ahead of 1939. Pontiac retail sales were up 48 per cent for the first six months of 1940 and Oldsmobile sales jumped 42 per cent.

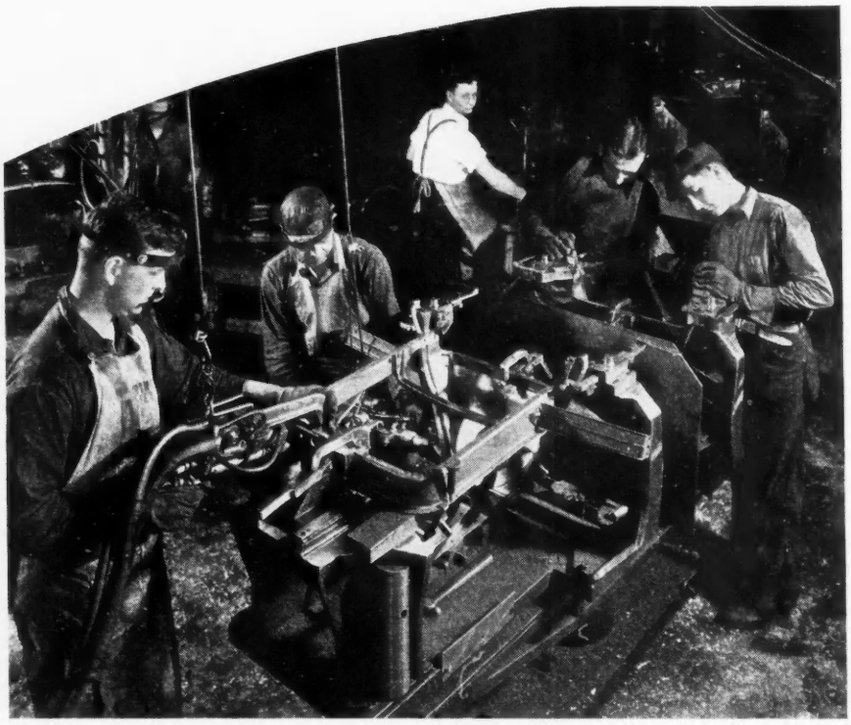
Plymouth retail deliveries for the week ending June 29 exceeded 19,000 units for the best week in the company's 12-year history. June was the second biggest month of 1940 for Chrysler retail sales. Hudson June sales were 57 per cent ahead of 1939. Nash 1940 model production of 62,131 was 25 per cent above 1939.

New passenger car registrations from 47 states for May showed a gain of 23.3 per cent over May, 1939, according to R. L. Polk & Co. The May total was 341,791 units compared to 348,632 in April, 1940. New passenger car registrations for the first five months of 1940 have run 28.4 per cent ahead of 1939.

AUTOMOTIVE MANUFACTURING ACTIVITY turned upward and then downward again for the weeks ending June 22 and 29, as indicated by the unadjusted index figures of 254 and 250 plotted on the accompanying chart.

[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp. New York. 1926 = 100; [3] Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.

BUSINESS ACTIVITY

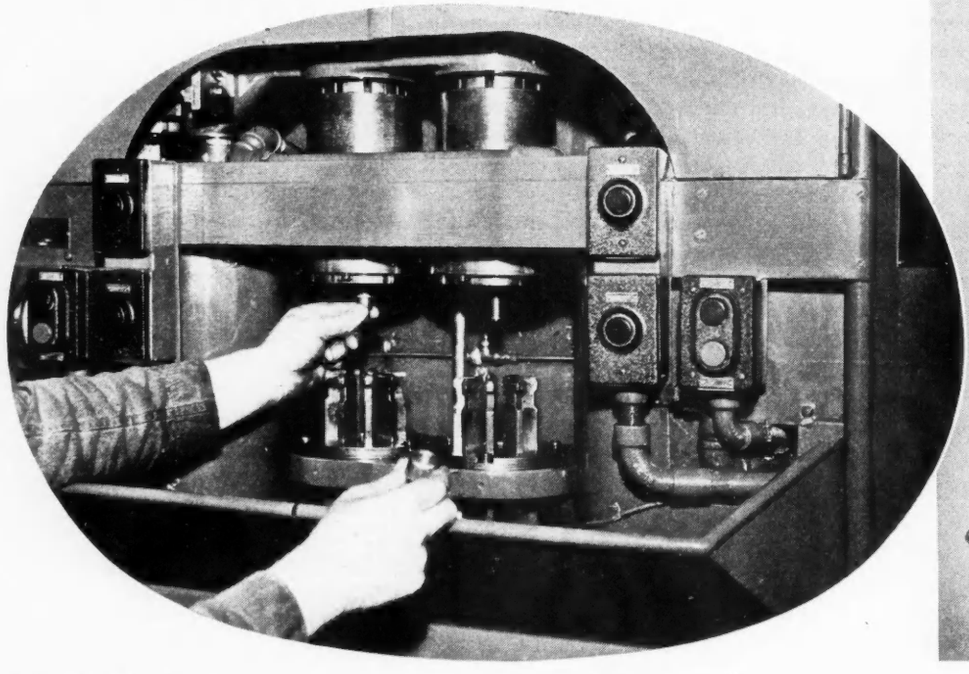


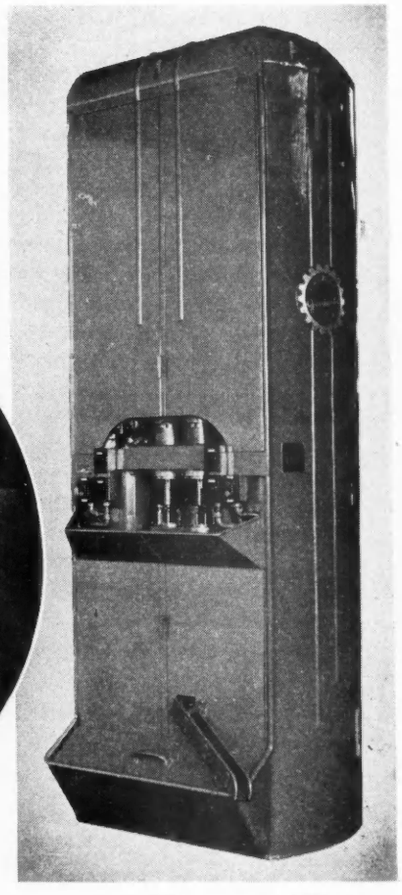
*Part of an installation of six Westinghouse electronically controlled gun-welders in a modern radiator and grille assembly department of an automobile plant.*

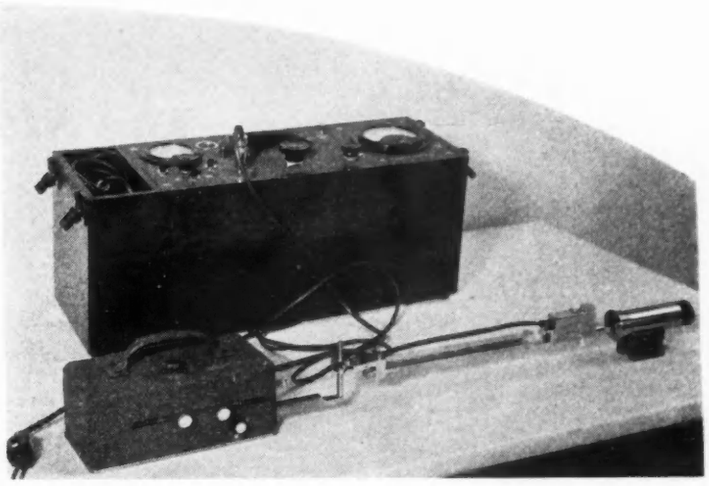
# MEN and

SURFACE finish is getting an increasing amount of attention as evidenced by the rapidly swelling total of papers presented before technical groups on this subject. Another "straw in the wind" that indicates the emphasis in this direction is the publication of the *Story of Superfinish* which combines in one thick volume the history of the process developed by Chrysler Corp. and a treatise on the science of surface finishes in general (see page 58). Then, too, about 200 top-flight engineers recently descended on the Massachusetts Institute of Technology to discuss heatedly for three days the closely related subjects of friction and surface finish. A report of the latter was made on page 11 of the June 15 issue of AUTOMOTIVE INDUSTRIES. The subject of surface finish also got considerable attention at the National Production Meeting of the Society of Automotive Engineers held in May. One of the papers presented at the SAE meeting was "Surface

*(Right) Front view of the "Gearbroacher." This machine arranged to broach out nine teeth in steel starter gear for automobile starter. (Oval) Close-up view of work locating arbors, broach shanks and automatic pulling heads on "Gearbroacher." The operator is slipping one gear blank on the left arbor while one of the blanks can be seen in his other hand.*







*Profilometer with "One Microinch Scale," product of Physicists Research Co.*

# MACHINES

Finish Control in Machine Shop Practice" by R. F. Gagg, Wright Aeronautical Corp.

In this paper Mr. Gagg observes that "Nearly everyone who has contact with manufacturing meets the problem of determining whether a machined surface is proper for its intended use, whether a different finish could be substituted, whether the cost of the finishing operation could be reduced without a performance penalty, and many similar questions. Without a reasonably exact measure of the quality of surface finish, the discussion generally resolves itself into an argument which largely rests on personal opinions and interests." Following this Mr. Gagg presents a neat summary of what has been done to standardize terminology and definitions, then lists and briefly describes the principal methods and instruments now being used to measure surface roughness before plunging into the heart of his discussion.

"By establishing surface roughness standards for application to products on the basis of actual current shop procedure," says Mr. Gagg, "most of the objections to the introduction of surface roughness control are removed. In most cases it will establish standards for the finish required without changes in existing shop procedure. It frequently has been found that even in making initial application manufacturing personnel will perceive savings in process costs which can be applied immediately prior to adoption of the roughness standard for the part without adverse effect on the products.

"Numerous instances," he claims, "have been encountered where an expensive hand-finishing operation, originally adopted largely because of its effect on appearance, was abandoned with an improvement of products. It is extremely important to keep accurate records of materials, finishing processes used, part numbers, and similar information correlated with roughness measurements used in establishing the standards to be adopted. These data provide a useful source of information for future use in setting up new work on other parts which are required to conform with a finish standard. In most cases, it is advantageous to preserve a sample representing the minimum of acceptability for the part in question, even though a direct record of the surface roughness is obtained with a measuring instrument. These samples may be used for comparison in visual inspection of the surface finish in subsequent production work. For most purposes, such comparisons are quite adequate as an inspection control procedure."

Mr. Gagg maintains that it is not generally necessary, in fact for most products it seems undesirable, to specify a direct control of surface roughness by inspection with a sensitive measuring instrument. In his opinion the sensitive measuring instrument may be used for occasional checks on the quality of the work being turned out, and may be used to umpire any differences of opinions which may develop. It also serves

*New profiling machine built by the National Broach & Machine Co.*

*Arthur M. Swigert, Jr., author of "The Story of Superfinish."*

# The Story of Superfinish

The Story of Superfinish by Arthur M. Swigert, Jr., director of production research for Chrysler Division, Chrysler Corp., was published recently by the Lynn Publishing Co., Detroit, Mich. This book of 672 pages and 720 illustrations deals not only with the development of the superfinishing process by Chrysler Corp. but forms a treatise on the science of surface finishes in general.

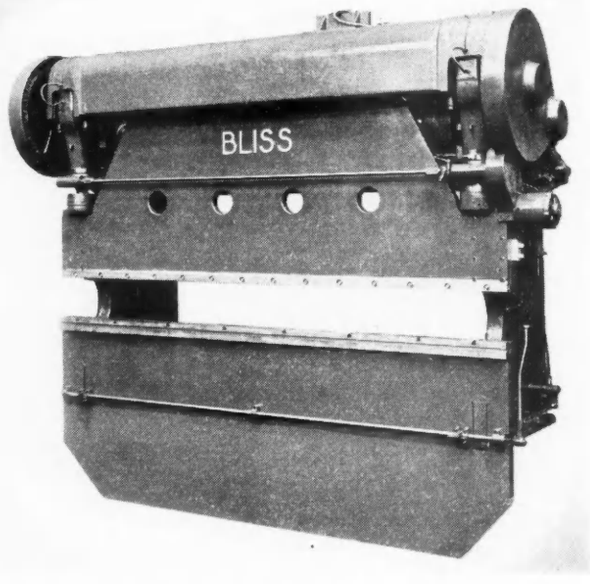
It is brought out in the work that what led to this Chrysler development was the observation that when automobiles were shipped by rail over long distances, the roller bearings of the rear axles would "brinell", that is, indentations would form in the bearing cups directly over the rollers supporting the load, and that such brinelling could be prevented by carefully hand-lapping the cups. A thorough consideration of the problem led to the conclusion that brinelling in transport is due to the fact that the rollers bear not on a continuous surface but only on the peaks of protuberances above the base metal of the cup, and that if these protuberances were removed and a dead-flat surface obtained, brinelling would not occur.

Hand-lapping, of course, was not a good production process. The development of a production method for removing the "grinding fuzz" from the bearing surfaces of the cones of roller bearings was undertaken by D. A. Wallace of the Chrysler Corp. early in 1934. Further development of the process was conducted in cooperation with bearing manufacturers, machine-tool builders, and others, and the development created such interest in the mechanical industries that more than 6000 executives visited the Chrysler plant during the past three years to familiarize themselves with the process at first hand. While at first the process was used only on the races of anti-friction bearings, it is now applied to many other automotive and general mechanical parts.

So far as the reviewer knows, this is the first book in the English language devoted to the science of surfaces or surface finishes. It contains a wealth of information all more or less pertinent to the subject, and should prove helpful particularly to those who are confronted with production problems in which surface finish is a factor.—P. M. H.

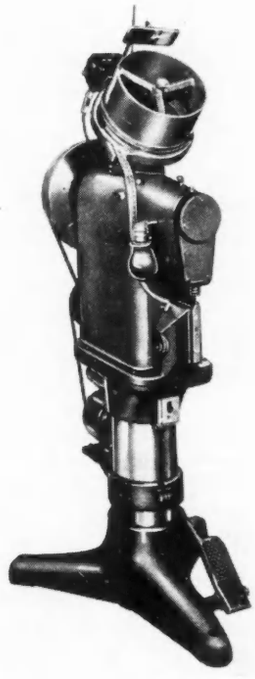
an essential purpose, he points out, in the measurement of new pieces to establish conformity with the specified standard for surface roughness which appears on the drawings. This is held to be desirable because surfaces of the same degree of roughness made with minor variations in manufacturing process, or made from different materials, may look different and therefore need a reference control measurement of roughness. Differences in shape apparently sometimes will serve to alter the appearance of surfaces of nearly equivalent roughness to a rather high degree. Where simple visual comparison of a sample and work pieces being inspected for grade of surface roughness is not conclusive, the use of a comparison miscroscope having a field of vision optically split between the sample and the work being inspected with exactly equivalent illumination conditions on both pieces is said to be a very helpful device. In Mr. Gagg's opinion the comparison microscope also should be utilized by the man doing the work in the shop for best results in strict control of quality.

"A useful by-product of the surface roughness measurement and control work," Mr. Gagg continues,




*Latest addition to the E. W. Bliss Co.'s line of all-steel press brakes.*

"is found in manufacturing process development. The use of a tracer type of measuring instrument makes it possible to obtain an immediate indication of the effects of process changes such as variations between grinding wheels or lapping compounds during the course of the experiment. Most helpful information is provided by measuring instruments of the type which give an indication of the character of the details of the surface profile being measured. This is especially true in cases where high velocity rubbing surfaces or other moving parts are concerned. Even though the graphic record or other indication of the profile shape is somewhat distorted, it is still very useful as accessory information. Lack of a perfect reproduction is a minor handicap compared to the benefits derived from the whole procedure. Savings effected in time required to complete a job and time of high-priced supervisory personnel are frequently substantial items. Following this kind of procedure frequently makes it possible to eliminate several expensive steps in experimental service trials or similar operating tests. During such work, it is essential to keep accurate and comprehensive records of the effects of changes made for use in establishing future procedure."



***Machine designed by Fabri-Steel Products, Inc., for rapid setting of Fast-On lock nuts.***

In the concluding paragraphs of this paper the author points out that since requirements for surface roughness control have become widely used, some purchasers have required that machine tools bought for a specific job shall be capable of producing a product with a specific grade of roughness on certain surfaces in addition to the ordinary requirements for production capacity, etc. It is stated that this has indirectly had the effect of improving production tools at the source rather than by more expensive alterations while in service, and such requirements undoubtedly will become common practice.

***"Incolap" gear finishing and correcting machine built by Gear Processing, Inc.***

IN CONNECTION with the foregoing it is interesting to note that the Physicists Research Co., Ann Arbor, Mich., has developed two new accessories and a new instrument modification which are said to greatly extend the applications of the Abbott Profilometer in measurements of surface quality.

The first of the accessories is the Motortrace, an instrument for mechanical operation of the tracer. Its field of application is as follows: a. Very narrow surfaces and small areas where the available tracing distance is only 1/32 in. to ⅛ in.; b. In awkward places near shoulders and holes, where the tracing distance is restricted; c. On very smooth surfaces (e.g., ½ to 2 micro-inches) where extraneous vibration makes manual tracing difficult; d. In small holes or other surfaces measured with the Type 1 Tracer described below.

Two motions are provided. The first is a constant speed linear motion, automatically reversing at both ends, with length of stroke ¼ in. to 2¼ in. adjustable

(*Turn to page* 67, *please*)

***Two-gun portable spot welding equipment manufactured by the Progressive Welding Co.***

# *Fourteen papers on wide range of subjects draw A S M E members to*

# Oil Power

By P. M. HELDT

THIS year's meeting of the A.S.M.E. Oil and Gas Power Division took place at Asbury Park, N. J., June 19-22. The program was of more than ordinary interest from the automotive standpoint. At a session devoted to shaft couplings, papers were read on hydraulic and electric slip couplings. The hydraulic couplings discussed are of the same design as those which have found their way into passenger automobiles in recent years, and the electric slip couplings have the same general characteristics and serve the same purpose. At a session on mechanical design there were papers on stresses in reciprocating parts, on engine balance, and on frame stiffness. Other sessions were devoted to Diesel fuels, marine Diesel engines, and research, while at a general session papers were read on the combustion-gas turbine and on air cleaners. Franklin B. Wood of the Rural Electrification Authority, Washington, D. C., was the speaker at the banquet, which was held on Friday evening, June 21. More than one hundred members and guests had registered up to the end of the second day of the meeting. Following are abstracts of the papers of chief automotive interest.

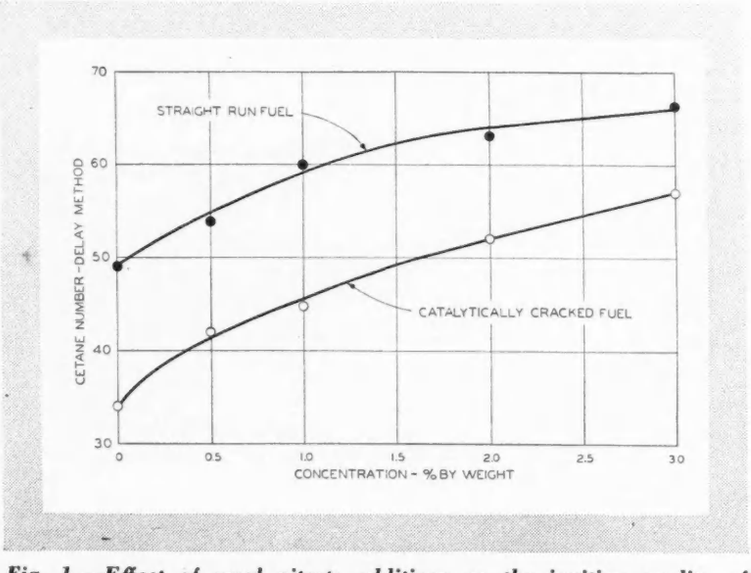



***Fig. 1.—Effect of amyl nitrate additions on the ignition quality of Diesel fuels***

### *Houdry Process Diesel Fuels*

The Houdry catalytic-cracking process has been widely publicised as a means of producing gasoline of high anti-knock quality. W. S. Mount and E. T. Scafe, of Socony-Vacuum Oil Company, presented a paper in which they endeavored to show that it can be used also to produce a valuable distillate fuel, and when so used will give a greater total liquid recovery than thermal cracking alone. At the present time about one-half of all of the gasoline produced originates in the cracking still, whereas the fuels now used for domestic heating and in high-speed Diesel engines are straight-run distillates. It is generally known that cracking tends to give high-octane number, and as fuels of high-octane number usually have a low cetane number, it would be expected that Diesel fuels thus produced would be of low ignition quality.

A comparison was made in the paper of the yields from a Mid-Continent crude when processed with Houdry equipment and with conventional thermal-cracking equipment respectively. It was shown that the cetane number of the Diesel fuel produced is equal in both cases until the amount of straight-run fuel distillate from the crude is exhausted. Thereafter the much lower cetane number of the thermally-cracked distillate (35) as compared with that of the Houdry-cracked distillate (46) results in lower cetane numbers in the blends containing the former. The yield in gasoline was said to be greater in all cases when the Houdry equipment is used.

A table included in the paper gave the cetane numbers of Diesel fuels obtained by the Houdry process from a wide variety of crudes, and of straight-run Diesel fuels from the same crudes. Houdry-cracked fuels from Pennsylvania and Oklahoma City crudes are only slightly lower in cetane number than the straight-run products of similar physical characteristics. Fuels from other crudes tested showed ratings as much as 14 cetane numbers lower than corresponding straight-run stocks. Three of the 11 crudes gave Houdry Diesel fuels of more than 50 cetane number, which are adapted for use in high-speed Diesel engines.

# Conference

In the case of gasoline, anti-knock compounds came into use early in the art, because straight-run gasoline was relatively poor in anti-knock quality. The reverse situation exists with respect to Diesel fuels. The straight-run product is most satisfactory, and at the present time here is more than sufficient of this to meet all requirements. When this situation no longer exists and a high-cetane-number fuel is required (said the author) it will be necessary to use ignition accelerators to improve the quality available in cracked stocks.

Fig. 1 shows the extent of cetane-number improvement obtainable by the addition of amyl nitrate in different proportions. It will be seen that both the catalytically-cracked (Houdry) and straight-run fuels are equally susceptible to improvement, and that 1 per cent of the addition agent increases the ignition quality by about 11 cetane numbers. Amyl nitrate at present costs about 10 cents per pound, hence the use of this addition agent in the proportion mentioned would add 0.72 per cent per gallon to the price of the fuel. As regards other physical qualities, Houdry Diesel fuels are similar to straight-run fuels.

### *Hydraulic Couplings*

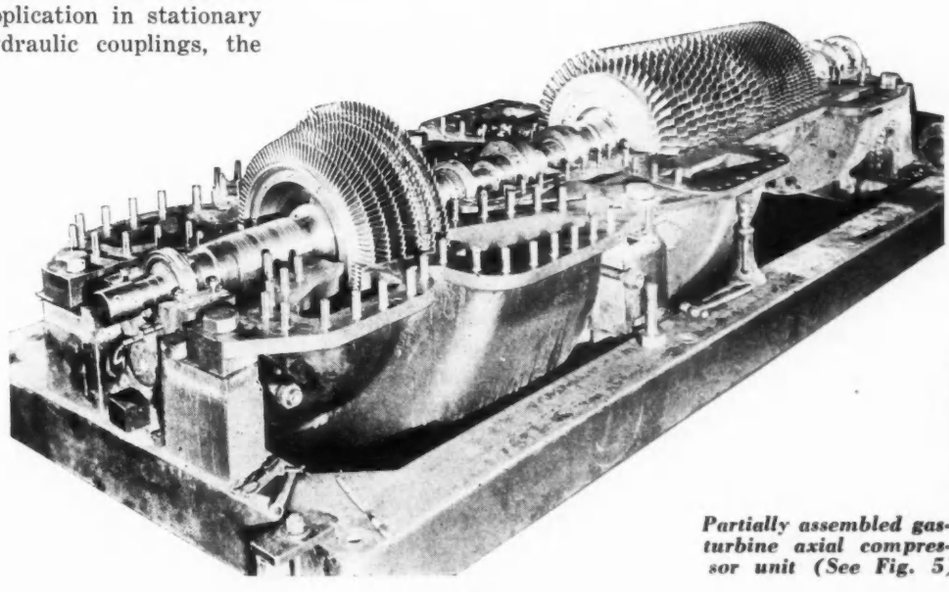
Hydraulic couplings for internal-combustion-engine application were discussed by N. L. Alison, R. G. Olson, and R. Nelden of the American Blower Corporation. They traced the historic development of this type of coupling and dealt with its application in stationary and marine installations. Hydraulic couplings, the authors said, are built of welded steel, cast iron, or cast steel, according to the requirements of each installation. For use with high-speed Diesel engines, where relatively light weight and low $WR^2$ are desirable, welded couplings are generally used while large low-speed couplings, such as are now being used in U. S. Maritime Commission C-2 cargo vessels, are of cast construction. Due to the smoother surfaces and the thinner vanes of the welded couplings, their slip is somewhat lower, especially in the smaller sizes, but in the case of large low-speed couplings this difference in slip becomes negligible. In all sizes, the lower slip of the welded couplings can be compensated for by only a small increase in the diameter of the cast couplings. The latter construction is appreciably lower in cost and is more readily adaptable to the higher $WR^2$ requirements of the low-speed engine.

For extremely high speeds, such as are encountered where the hydraulic coupling is used as a disconnecting clutch between the main and cruising turbines in certain types of naval vessels, the rotating members are made from solid steel blocks, the radial passages being machined out by a milling operation. After this machining operation is completed, small steel sections which form a semicircular core ring, are welded in place.

When the coupling is used for driving engine-attached scavenging blowers, and cast construction is used, the driving member may be made of cast aluminum as a means of keeping the $WR^2$ of this member as low as possible.

### *Electric Slip Couplings*

The hydraulic coupling has a counterpart in the electric slip coupling, of which little has been heard in the automotive field in recent years. Such a coupling formed part of the Owen Magnetic system, which acted as an electro-magnetic torque converter in low-speed, and as an electro-magnetic coupling in high speed. It seems that these electro-magnetic couplings have come into rather extensive use in connection with Diesel engines in the marine field in recent years, and A. D. Andriola of the Electric Boat Company presented a paper on "Electric-Slip Couplings for Use with Diesel Engines."



*Partially assembled gas-turbine axial compressor unit (See Fig. 5)*

ENGINEERING

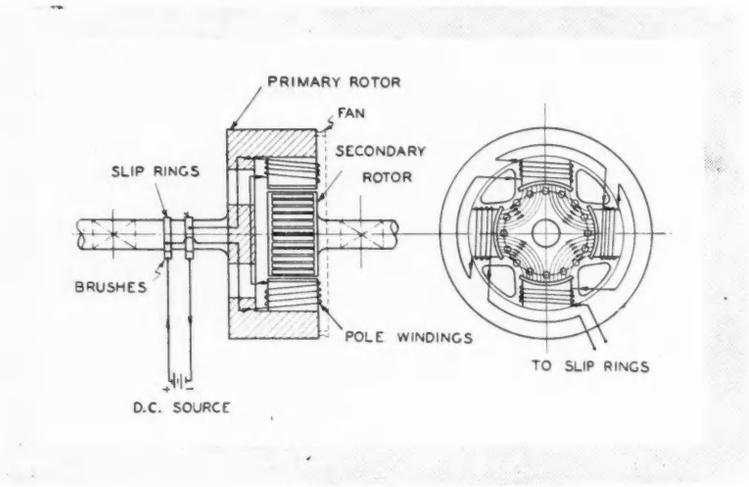



*Fig. 2—Diagram of electric slip coupling*

Last year, in this country alone, at least 20 vessels totaling 48 units were equipped with electric slip couplings. In this application the electric coupling offers the advantages that it reduces peak pressures on the gear teeth and permits two or more engines to be rapidly coupled to or uncoupled from the gearing to a common propeller shaft.

Referring to Fig. 2, the unit consists of two concentric rotors separated by a radial air gap, a set of slip rings and brushes, an external source of direct-current supply for energizing the primary coils, and a control box. One rotor is a multi-polar magnetic ring whose poles are energized by direct current; the second, a magnetic core with a short-circuited winding consisting of heavy copper bars placed in insulated slots parallel to the rotor axis, which are short-circuited at both ends by means of rings welded to the individual bars. Either one of the two rotors may be made the driving member; the one carrying the short-circuited winding is inherently the more rugged, for which reason it is preferably made the driving member. This arrangement also gives the rotating system of the engine a higher natural frequency, which is desirable from the standpoint of freedom from troublesome torsional vibration. The author said that irrespective of which is the driving member, the pole ring is referred to as the primary and the short-circuited member as the secondary.

Very small slips induce large currents in the secondary. At full load the slip is of the order of 1 per cent, and the efficiency therefore is very high. Characteristic curves showing the variation of torque (in percentages of the full-load torque) with percentage of slip for different degrees of field excitation are shown in Fig. 3. Up to about 10 per cent slip the torque increases with the slip, while beyond that point the torque decreases as the slip increases. These represent regions of stable and unstable operation, respectively. As long as the slip is less than 10 per cent, if the torque load increases, the slip increases until the torque produced by the coupling equals the torque load, and equilibrium is restored. This would evidently be impossible if the coupling were operating in the unstable region, that is, at more than 10 per cent slip. For proper operation, the coupling must be so designed that the maximum torque capacity is substantially above that which it will be required to transmit under normal conditions of operation. One firm designs its couplings to have a capacity of 170 per cent of the normal full-load torque. Under rapid variations of torque the resultant electrical effects increase the stalling point to about 300 per cent of the rated value, which further reduces the possibility of instability under average driving conditions. Variation of the torque with slip for different engine speeds is shown in Fig. 4. It will be seen that the maximum torque is independent of the speed.

There is much similarity between the electric slip coupling and the squirrel-cage type of induction motor,

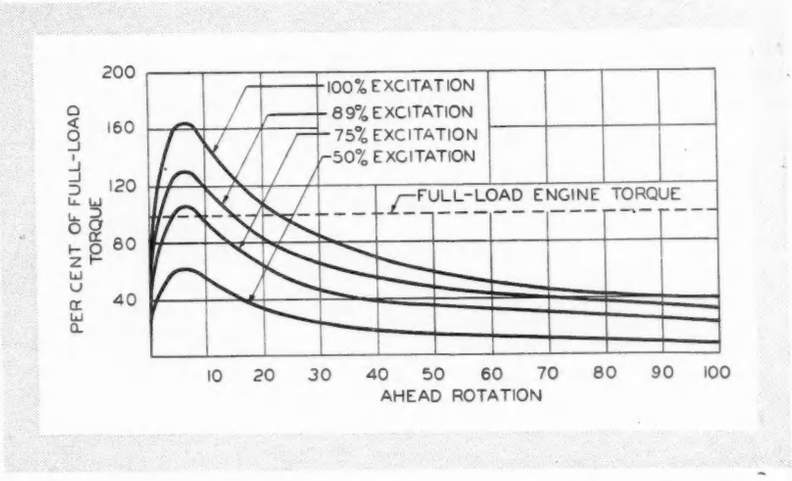



*Fig. 3—Relation between torque and slip with various degrees of excitation*

the principal difference being that whereas in the induction motor a rotating magnetic field is produced without physical motion by the three-phase current, in the coupling it is produced by actual rotation of the field structure, which is magnetically excited by direct current. A mechanical difference between the two types of apparatus is that in the coupling the two rotors are overhung on their respective shafts, which necessitates an air gap about four times as wide as in an induction motor. This, of course, increases the exciting current required.

Cooling requirements of the coupling are similar to those of electric motors, and are met by the provision of a radial-bladed fan in the outer rotor and ventilating openings in the web of same. Operation of the coupling can be controlled by means of a switch in

the direct-current primary circuit.

As both hydraulic and electric couplings are being used for geared marine drives, the author made a comparison of the two types from the standpoint of this particular application. Each coupling requires auxiliary equipment, which may be regarded as a disadvantage. In efficiency, each averages about 97 per cent. For hydraulic couplings the loss is approximately a fixed percentage of speed, and with economy resistance control this applies also to electric couplings. For speeds below 400 r.p.m. the electric slip coupling has the advantage with respect to weight and size, and the author expressed the opinion that this speed limit might be raised considerably as more experience is gained. As regards rapidity of coupling action, the electric coupling is superior. In the author's opinion, where direct current is available, the electric slip coupling is preferable to the hydraulic type; in other cases, with weight and size equal, the choice depends on the relative costs.

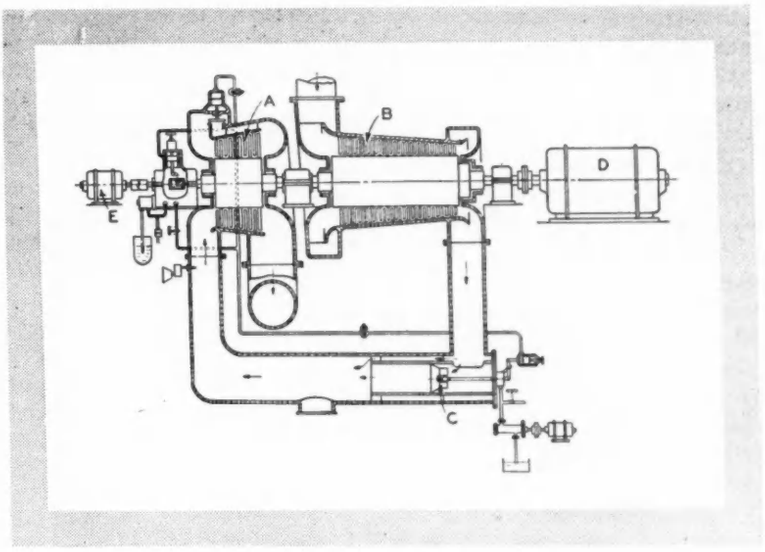



*Fig. 5—Gas turbine power unit*

## The Gas Turbine

"The Combustion-Gas Turbine" was discussed by J. T. Rettaliata of Allis-Chalmers Manufacturing Company. The unit dealt with in the paper is a stationary one, but as the subject of internal-combustion turbines for automobiles, airplanes, ect., is sometimes brought up, some of the principles involved should interest our readers. In the accompanying illustration (Fig. 5), *A* is five-stage gas turbine which is direct-connected to the fifteen-stage axial compressor *B* that delivers air under about 45 lb. per sq. in. pressure to the oil burner *C*. Only a part of the air delivered is used for combustion purposes, the remainder passing through the annular space surrounding the burner and mixing with the product of combustion at the outlet from the burner. Diluting the products of combustion with air before they enter the turbine is necessary in order to keep down the temperature of the gases to about 1000 deg. Fahr., which is the maximum the turbine blades will withstand successfully. In the illustration, *D* is a generator driven by the gas turbine, and *E* a starting motor, which latter serves to bring the turbine up to about 25 per cent its normal running speed, at which speed it develops enough power to operate the compressor.

The cycle of this gas turbine is as follows: in the compressor the air is compressed isentropically to 45 lb. per sq. in. gage. Then by the addition of heat in the burner the volume of the gas is greatly increased, but the pressure is not changed, and the gas enters the turbine at 45 lb. per sq. in. In the turbine it expands isentropically, and after having passed through the turbine it is discharged at atmospheric pressure. With a cycle of this kind, the same as with the Otto cycle, the efficiency of heat conversion is dependent on the temperature range through which the gases are carried in the turbine, and as the maximum temperature is limited to 1000 deg. Fahr. by the material used in the blades, the thermal efficiency of the turbine is rather low, of the order of 16 per cent (brake thermal efficiency), which is only about one-half the efficiency of the Diesel engine. If a blade material could be developed that would withstand an operating temperature of 1500 deg. Fahr., the efficiency could be greatly increased. The disadvantage of this low thermal efficiency of the gas turbine is offset by the fact that it will burn the lowest grade of bunker fuel, which is said to cost only about one-half as much per gallon as the gas oil required for Diesel engines.

At the present time the principal commercial application of gas turbines in the United States is in oil refineries. Air discharged from the compressor is used in a refinery process, and the resulting high-temperature gases are expanded in the turbine, producing power, the excess of which is used to drive a generator.

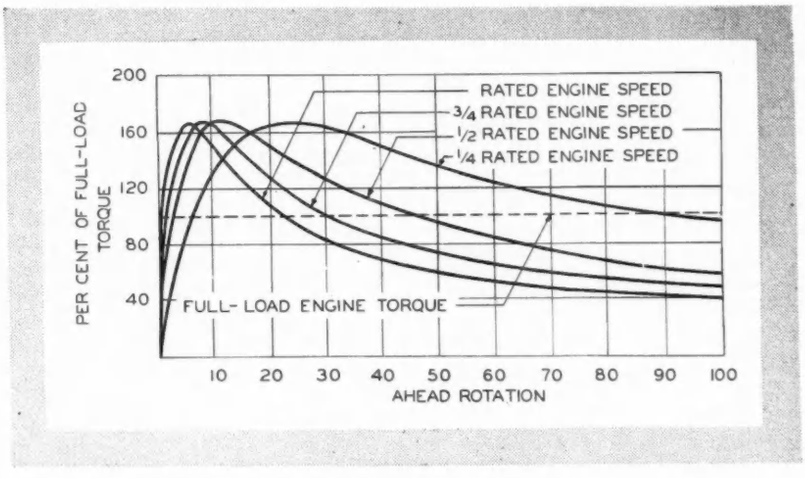



*Fig. 4—Relation between torque and slip with various engine speeds*

In this type of installation no combustion chamber is required, as the apparatus in which the process is carried out serves as the combustion chamber.

### *Frame Stiffness and Vibration*

Lateral Stiffness and Vibration in Engine Structures was the topic discussed in a paper by Russell Pyles, engineer of Clark Bros. Co., Inc., Olean, N. Y., particularly from the standpoint of relatively large locomotive and marine engines of the six-, eight-, and twelve-cylinder types. The engines referred to by the author have crankcase members—in the form of beams of either solid rectangular or channel section, one on the crankcase proper and the other on the base—which provide considerable transverse rigidity. These parts of the crankcase, which extend continuously over its entire length, are considered as a beam whose lateral stiffness is dependent on its length and its moment of inertia. This beam is subjected to the bearing load on the center bearing, and while the actual deflecting force is not the momentary load on the center bearing, but a certain harmonic of this load combined with the same harmonic of the loads on the other intermediate bearings, the deflecting force is *proportional* to the calculated load on the center bearing. The stress induced in the members which resist transverse deflection also is proportional to this bearing load.

Applying this method to a number of actual engines, Mr. Pyles found that a certain engine in which failure occurred that was remedied by changes in the frame to increase its stiffness, gave a calculated deflection of 0.007 in., while four other engines that operated satisfactorily all showed deflections not exceeding 0.0035 in., and he concluded that if the frame (or crankcase) deflection calculated in the manner outlined by him does not exceed 0.0035 in., the rigidity is likely to be satisfactory.

The author also mentioned that the lateral stiffness of the frame and its natural frequency of vibration in the transverse direction are closely related. After the engine has been built its natural frequency can be determined by mounting a variable-speed, unbalanced, rotary weight on its side and taking vibrograph records. That, however, is too late to be of use in the design work.

### *Air Cleaners*

"Characteristics of Air Cleaners Used on Diesel and Gas Engines" was the title of a paper by William K. Gregory of American Air Filter Co., Inc. According to Mr. Gregory, it is a relatively easy matter to design an air filter having a cleaning efficiency of nearly 100 per cent, but it is not so easy to combine this high efficiency with low resistance to air flow and low maintenance cost. Mr. Gregory divided air cleaners into dry felt-type filters, oil-coated viscous impingement type filters, automatic self-cleaning filters, and oil-bath air cleaners. While oil-bath cleaners have considerably more resistance to flow than other types, the author said this is not a serious disadvantage, and is overshadowed by the advantages of the type. A simple form of oil-bath filter with a filter element of cylindrical shape is shown in Fig. 6. Dust-laden air enters the annular passage at *A*, is directed downward by baffle *B*, and passes around the bottom of this baffle just above the surface of the oil. The velocity through this passage is such that a certain amount of oil is picked up by the air stream and carried into the filter element *C*, which is thus wetted with oil. Air in passing through this oil-wetted filter cell is cleaned by the impingement method. Fairly uniform distribution of air flow through various sections of the screen is maintained by adjusting the height at which the air enters the center tube. Some models are so designed that the baffle *B* can be raised or lowered to compensate for variations in rate of air flow, thereby ensuring the proper effect on oil flow.

Fig. 7 shows another type of oil-bath air cleaner. Air enters tangentially at *A* and causes a swirling motion which produces a low-pressure zone in the center of the cylinder. Oil is picked up by the air stream and carried into the filter cell *C*. The oil level is kept slightly above baffle *B*, which latter limits the amount of oil that may be carried into the filter cell, and also serves to damp the circulation of oil below it, thus permitting dust to settle in sump *E*. Some of the oil carried up into filter cell *C* works over to the edges and drips back into the oil reservoir through orifice plate *D*. Filter cell *C* consists of a thick pad of crimped wire, and the air is cleaned by impingement against oil-coated baffles. Circulation of the oil is depended upon to wash out the dust as it accumulates in the filter cell.

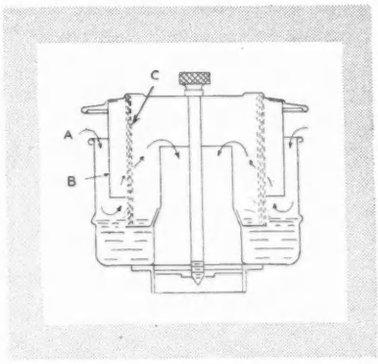



***Fig. 6—Oil-bath-type of air cleaner with cylindrical filtering unit***

With respect to the resistance to flow of the oil-bath type of air cleaner the author had the following to say:

"Resistance of 1 in. water column reduces the oxygen available for combustion by approximately the same amount as increasing the elevation at which the engine is operating by 66 ft. A resistance of 6 in., therefore, would have about the same effect on power delivery as increasing the elevation by 396 ft., which in most cases will not effect engine operation or seriously reduce power delivery. In this connection, we must also bear in mind the fact that the resistance of a properly-designed oil-bath air cleaner remains constant, whereas the resistance of a dry-type filter may vary all the way from 0.1 in. to as much as 20 in. of water column, if servicing is neglected, and the resistance of a washable type viscous impingement filter may vary from ¼ in. to as much as 4 in."

The author made the claim that, except for its higher resistance to flow, the oil-bath air cleaner is superior to other types, as it can be made to show from

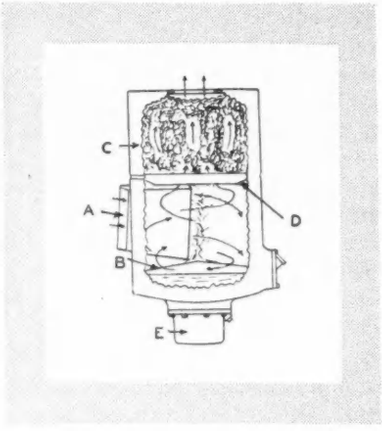



*Fig. 7—Oil-bath type of air cleaner with swirl chamber*

99.65 to 99.9 per cent cleaning efficiency throughout the capacity range, and to require only about the same amount of maintenance as the automatic self-cleaning filter, which is less than that required by either the dry type or the washable unit type.

### Atmospheric Conditions and Engine Performance

The Pennsylvania State College for some years past has been engaged in a study of the effects of changes in atmospheric conditions on the performance of Diesel engines. All of the earlier work was done on four-stroke engines, but during the past year a two-stroke single-cylinder horizontal engine was used in the tests. It had a bore and stroke of 9 by 12 in. and operated at 300 r.p.m. Scavenging air was compressed by the crank side of the piston in a chamber separated from the crankcase. While the cylinder size is relatively large (from the automotive standpoint) and the speed low, the effects of changes in atmospheric conditions presumably would be the same for engines with smaller cylinders and operating at higher speeds, so that the conclusions have general validity.

Three series of runs were made to study the effects of changes in (a) the humidity of the air supply, (b) the temperature of the incoming air, and (c) the atmospheric pressure. For each run with these variables held constant, specific fuel consumptions were determined for at least ten different loads, varying from about 30 per cent of the rated load to the maximum obtainable under conditions of steady operation. To investigate the effects of humidity, runs were made at intake temperatures of 80 and 120 deg. Fahr., respectively. The results were plotted on curve sheets —specific fuel consumptions along the vertical and brake horse powers along the horizontal axis—with individual curves for different degrees of humidity, different air temperatures, or different air pressures.

It was concluded from the results that the performance of two-stroke engines varies directly with the amount of air present in the cylinder at the time of combustion. If the load is below that corresponding to minimum specific consumption, a decrease in the air density of as much as 15 per cent has little effect on the consumption. If, on the other hand, the load is greater, then any change in intake-air pressure, temperature or humidity, or in the exhaust back pressure will influence the amount of air taken into the cylinder, and as there is then insufficient air present to burn all of the fuel, it will affect both the specific consumption and the maximum output. In a two-stroke engine, moreover, if the pressure difference between the source of scavenging air and the main cylinder is abnormally small, changes in either the exhaust or intake pressure will measurably affect the air flow into the engine and will change both the specific fuel consumption and the maximum power output.

### Stresses in Reciprocating Parts

As the speed of Diesel engines has been increased it has become necessary to reduce the weight of reciprocating parts and to distribute the material in them to best advantage from the standpoints of strength and rigidity. R. L. Boyer and T. O. Kuivinen of The Cooper-Bessemer Corporation discussed the stresses and deflections which occur in the reciprocating parts of internal combustion engines. The paper contains rules for the dimensioning of pistons, piston pins and connecting rods. The designs considered are used in rather large multi-cylinder marine and stationary engines and seem to be somewhat heavier than customarily used in automotive-type engines.

Paul S. Shirley, research engineer of the Diesel Engine Division of General Machinery Corporation, presented a paper on Engine Balance. It was a general treatment of the subject of engine frame vibrations caused by unbalanced rotating and reciprocating parts and by variations in the side thrust of the pistons against the cylinder wall. Torsional vibration of the crank train was not considered.

Nordberg's contribution to the United States Maritime Commission program was dealt with in a paper by R. W. Bayerlein. An initial contract was placed by the Commission with the Tampa Shipbuilding & Engineering Co. for four ships of the C-2 type, equipped with two Nordberg Diesel engines arranged for direct connection to a single propeller shaft through hydraulic couplings and gear sets. These engines, which were to deliver 6000 hp. at the propeller shaft continuously, and 25 per cent more for short periods, were the most powerful that had been selected for a geared installation in this country up to that time. Recently an order for four additional ships was placed with the same builder.

Louis R. Ford, editor of *Motorship*, traced the development of Diesel engines for marine applications and discussed the factors which have increased the proportion of Diesel-powered vessels in service. Ocean-going ships as well as those for coastal and inland waters were included. Among the topics dealt with were the rivalry between the double-acting and single-acting principles, competition between four-stroke and two-stroke engines, increase in rotative speed, use of reduction gears, use of hydraulic and magnetic couplings, supercharging, utilization of exhaust heat, fresh-water cooling, welded engine construction and the suppression of noise and vibration.

### Diesel-Exhaust Constituents

The increasing use of Diesel engines for transportation in mines and tunnels induced the U. S. Bureau of

Mines to make analyses of the exhaust gases from two four-stroke Diesel engines under different operating conditions, and a paper briefly describing the engines, the fuels used, and the test methods, and giving the results obtained, was presented by John C. Holtz and M. A. Elliott. Both engines were of four-cylinder design; the piston displacements were 312 and 226 cu. in., and the maximum rated speeds 1400 and 2600 r.p.m., respectively. The fuel used had an A. P. I. gravity of 38.8, a cetane number of 78, contained 86 per cent of carbon and 14 per cent of hydrogen, and had a heat value of 19,910 B.t.u. per lb.

The accompanying chart (Fig. 8) shows the variations of carbon dioxide, oxygen, carbon monoxide, hydrogen and methane in the exhaust with the air/fuel ratio. For the fuel used in the investigation the chemically-correct air/fuel ratio is 14.75, and since Diesel engines seldom operate with an air excess of less than 25 per cent, only that part of the chart beyond 18.5 on the air/fuel ratio scale corresponds to normal conditions of operation. In the experiments the air/fuel ratio was varied between the limits of 11/1 and 100/1.

When the two engines were operated in their normal range of air/fuel ratios the concentration of carbon monoxide never exceeded 0.12 per cent, and hydrogen and methane never were present in significant quantities.

Despite its low concentration, it could be observed that the carbon monoxide in the exhaust was affected not only by the air/fuel ratio but also by the engine design and to a slight extent by factors varying with the engine speed. In tests with both engines the concentration of carbon monoxide reached a minimum with an air/fuel ratio of approximately 33.

Aldehydes, which are intermediate products formed in the direct oxidation of hydrocarbons, were present in the exhaust gases from both engines. The concentration of these compounds never exceeded 31 parts per million, and tended to increase with the air/fuel ratio. Preliminary studies have indicated that aldehydes may be partly responsible for the so-called acrid exhaust from Diesel engines.

Throughout the normal operating range of both engines, free carbon was collected on filter paper through which the exhaust gas was passed. Under these conditions the final exhaust generally was clear, although the calculated quantity of free carbon in the exhaust gas from one of the engines ranged from 2 to 6 per cent of the weight of the fuel. Free carbon in the exhaust increased rapidly when the air/fuel ratio

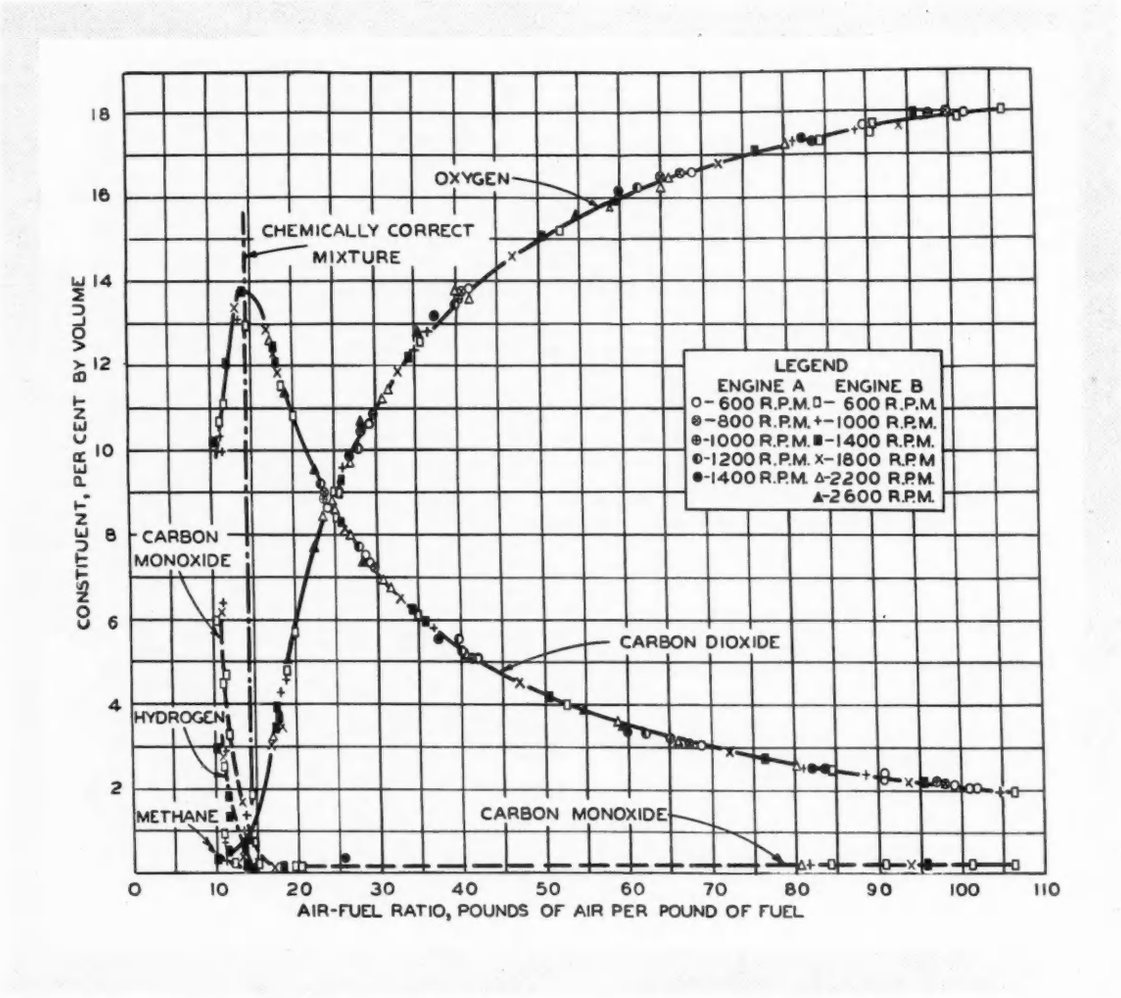



***Fig. 8—Relation between exhaust-gas components and the air-fuel ratio***

dropped below the minimum in the normal operating range, and when the concentration of free carbon reached about 0.3 lb. per 1000 cu. ft. of exhaust gas, smoke was easily noticeable.

The presence of aldehydes in the exhaust is indicative of chilling of direct-oxidation reactions, while the presence of free carbon with mixtures on the lean side is indicative of chilling of destructive (cracking) combustion reactions occurring in locally overrich regions.

In the normal operating range of an engine the potential heat lost in the products of incomplete combustion was between 1.5 and 5.5 per cent of the heat in the fuel. Therefore, incomplete combustion does not affect Diesel efficiency seriously.

# MEN and MACHINES

(*Continued from page* 59)

at both ends. The second motion is a cam driven constant-speed, quick-reversal reciprocating motion, adjustable from 1/64 in. to ⅛ in.

The other accessory is the Type 1 Tracer, a special tracer for measuring the roughness inside holes down to ½ in. diameter. A modification for still smaller holes is available on special order. It also is useful for measuring the roughness of gear teeth and other surfaces difficult to reach. The close spacing of the pilot skids of this tracer makes it desirable to use the Motortrace described above.

An instrument modification for fine work such as gages, etc., where greater sensitivity is essential, is the "One Microinch Scale" which is three times as sensitive as the standard Type P Profilometer. One of these instruments, with full scale readings of one-microinch, was built recently for the Lincoln Park Tool and Gage Co. The One Microinch Profilometer now is available on special order at slightly higher price, and except for the additional point on the range switch, is identical in size and appearance with the standard model. The Profilometer illustrated herewith has the one microinch scale.

A NEW profiling machine has been announced by the National Broach & Machine Co., Detroit. It is very rapid, entirely automatic and holds finished work to a tolerance limit of 0.002 in. No special mechanical skill is needed to operate this machine. Because it is entirely automatic (stopping itself at the end of the cutting cycle), one operator can handle more than one machine. He only is required to load and unload the two work fixtures. Profiling by the Red Ring method is restricted to the milling of profiles, internal or external, flat or undercut on parts having a profile pattern not larger than 6 in. by 8 in. by 2 in. thick where the cut is ⅛ in. deep or less on a face ¾ in. wide or less. The principal field of application for Red Ring profiling lies in the manufacture of parts for small arms and artillery breach mechanisms; the duplication of all kinds of flat cams; the profiling of airplane pistons and connecting rods to reduce weight; the production of instrument parts, accurate machine elements and electrical equipment parts.

The machine utilizes a closed differential hydraulic circuit to actuate its movement. This system includes a hydraulic pump which actuates the pistons by drawing a measured amount of fluid from one side and transferring it to the other. A second pump maintains and regulates the amount of pressure in the system.

The work table which carries two work fixtures (to double the rate of production) moves laterally. The spindle head which carries two spindles (one for each work station) moves at a right angle to the direction of table movement. These two principal movements are both reversible, and each is actuated by its own hydraulic cylinder. When the spindle head cylinder is working under feeding pressure, the table cylinder is working under holding pressure and vice versa. The change from feeding pressure to holding pressure is obtained by dogs which operate limit switches.

A master pattern or cam the exact size and shape of the finished work part is mounted rigidly to the bottom of the work table. A guide pin integral with the spindle head extends upward under the table to contact the periphery of the master cam. The location of this mechanism beneath the table avoids errors caused by chips and dirt. When the machine is put into motion the guide pin traces around the periphery of the master cam. Its motion is guided by maintaining the cam and guide pin in contact by means of changes from feeding pressure to holding pressure from point to point in its path as required by the shape of the pattern being profiled.

Cutter spindles are individually motor driven. Vertical adjustment is provided on the spindles to allow for slight variations in tool adjustment. The tapered guide pin is adjusted vertically by a graduated dial to compensate for cutter wear. Force feed lubrication is provided to all bearings and slides. The work table carrying the holding fixtures and the master profile cam is of ample proportions to accommodate large fixtures. Keyways and Tee slots are provided for locating.

E. W. BLISS CO., Brooklyn, N. Y., has produced a new addition to its line of all-steel press brakes. The machine has a capacity of ¼ in. by 12 ft. mild steel. Deflection in the bed and slide is held to a minimum by the use of generously proportioned beam members, providing rigid construction and a smooth, pleasing appearance. An electrically operated friction clutch

designed especially for the Bliss press brakes is employed on the machine shown herewith. Bronze bushings are provided for eccentric shaft and intermediate shaft bearings.

The press brake is fitted with a V-belt motor drive. Intermediate gearing is lubricated by oil or grease contained in oil-tight housings while guards for the larger gears retain the lubricant. Specifications for the Bliss brake illustrated are as follows: distance between housings, 12 ft. 6 in.; depth of gap, 12 in; stroke of slide, 3 in; adjustment of slide by motor 6 in.; distance bed to slide with stroke down, adjustment up 12 in.; the machine operates at 30 strokes per minute.

BECAUSE they speed assembly, give a stronger bond, and reduce rejects to a minimum, electronically controlled gun-welders have replaced former methods to assemble automobile bodies in some plants. In one modern radiator and grille assembly department, each of six gun-welders join 20 separate parts at 150 places in less than a minute. Because the gun-welded bonds are stronger, only half as many welds are used. The electronic control developed by Westinghouse engineers prevents burned spots, reduces rejected assemblies to a minimum, and requires no maintenance.

Spot, projection, flame and arc welding were all previously used. Conventional spot welding was particularly troublesome, producing burned spots and poor bonds. Appreciable quantities of work had to be repaired, and at times burns were so bad the parts were scrapped, especially body parts like fenders and cowls. Costly shut-downs and heavy maintenance were common due to burned contacting devices.

These gun-welders were designed by engineers of the Progressive Welding Co., Detroit.

THE Progressive Welding Co. recently announced a new two-gun portable spot welding unit. This machine is expected to eliminate the necessity for duplicate welding equipment and is designed for heavy-duty welding requiring high-point pressures, large capacity transformer and adjustable weld time control for accurate timing.

The unit illustrated consists of two spot-welding guns, transformer, air-hydraulic pressure booster, weld timer and contractor. Both the push gun (supplied with grounding clamp) and scissors type gun operate from the single transformer mounted in the base of the carriage. Welding point pressures up to 1000 lb. (for the scissors type gun) are supplied by the booster mounted above the transformer and operating from the standard factory air pressure line. Provision is made to water cool gun jaws and points through individual supply and return lines. Transformer is also water cooled.

Guns other than those shown can be supplied, depending on the type of work to be handled. Instead of the push type and scissors type guns, two scissors type or sliding contact guns could be used.

When the unit is to be used for more than one type of welding, a special weld timer having two separate control dials permits adjustment for two separate weld times for each gun. In this case, each gun is supplied with two control buttons, the operator using the proper button for the work to be welded. With this type of timer, two operators can use both guns simultaneously on different types of work.

A wide range of spot welding of heavier type can be handled by the new unit which is a companion model to a smaller capacity single gun unit manufactured by the company and recommended for the fabrication of lighter sheet metal.

THE American Broach & Machine Co., Ann Arbor, Mich., has developed a new machine which it calls the "Gearbroacher." With this machine each gear tooth is cut with an individual broach which is projected directly toward the center of the work and any changes that alter the pitch of the gear always bring the form of the tooth in proper relation to the center line and the adjacent teeth. The manufacturer points out that any error that might be created would be an individual error which could be detected and would not be an accumulated error, such as would be the case where the piece is indexed.

All teeth are broached with one stroke of the American "Gearbroacher," finishing a complete gear with each cycle of the machine, where one tooling set-up is provided on the equipment. Usually the machine is equipped with more than one tooling set so that the production then increases in proportion to the number of tooling set-ups that are operated at one time.

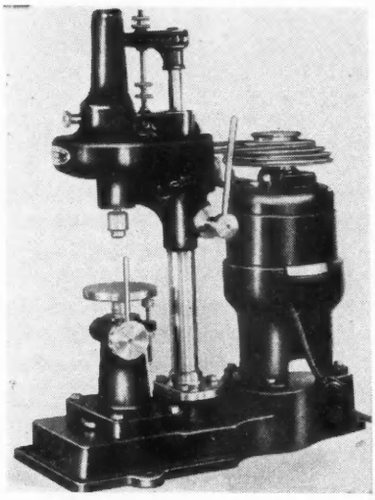
The machine itself is built of a welded steel column of cylindrical type which provides for greater rigidity than is usually found in the square or rectangular shape of column. It is designed purposely in this manner to provide proper mass and supporting webs and ribs under the guiding surfaces of the cross head.

The "Gearbroacher" is intended for broaching commercial gears and, where a precision gear is desired, this machine also fills a very useful purpose in being able to finish the gears to the point where they are ready for other final precision operations. The manufacturer claims that the machine is able to produce gears in this condition several times faster than other methods and at a very low tool cost.

GEAR PROCESSING, INC., Cleveland, Ohio, has developed a new "Incolap" gear finishing and correcting machine which is only 32 in. high, weighs 200 lb., and is designed especially for work on small spur or helical gears, multi-thread worms, and splines. It will accommodate gears from ¼ in. to 2 in. in diameter.

This bench model which is illustrated herewith has manual controls for stopping and starting, for lifting the gear for indexing or at the finish of the cycle, and for controlling the pressure between gear and lap. Provision is made for automatic control of these motions using time clock mechanism and actuating air cylinders. Length of stroke can be varied from 0 in. to 1 in. by a simple eccentric adjustment on the driving shaft. Maximum speed is 350 reciprocations per minute.

The process itself is very simple. It depends not on the skill of the worker, but on the same averaging effect employed in accurate gage production. Fundamentally, the success of the process lies in avoiding conjugate action and lapping all teeth of the gear



*New super-sensitive drilling machine added to the R-53 line built by the High Speed Hammer Co., Inc., Rochester, N. Y. Drilling range of the unit is from 0.004 in. to ¼ in. diameter, inclusive. Standard spindle speeds are: 750, 1500, 3000 and 6000 r.p.m.*

simultaneously. The averaging effect results from the fact that successive gears are unlikely to enter the lap in the same position relative to errors that the preceding gear occupied. Primary function of the Incolap machine is to reciprocate the gear and surrounding lap in relation to each other. On the bench machine the gear on an arbor reciprocates inside the lap.

A BRIEF resume of other new developments in machine tools and allied equipment follows:

*Fabri-Steel Products, Inc., Detroit*—A machine for setting "Fast-On" lock nuts where large scale production is required. Nuts are fed from a continuous rotating hopper (capacity 1000 one-quarter inch nuts) to an anvil where the clutch is tripped and the "Fast-On" nut is locked in place.

*Elwell-Parker Electric Co., Cleveland*—Power industrial crane, model C-4, with rated capacity of 3000 lb. at a 7-foot radius and travel speed up to 5½ m.p.h. Standard telescoping boom, 12 ft. to 19 ft., slews approximately 300 deg. in 20 sec. Hook speed, 30 ft. to 50 ft. per minute.

*Atlantic Abrasive Corp., South Braintree, Mass.*—Two new grinding wheels. Atlantic Type L.B. is made for fast, clean cutting on tool or dies. Type S.B., which like the former, comes in all grain sizes, is a medium tempered wheel for grinding all fine tools made of high-speed steel, stellite, carboloy and other alloyed steels.

*The DeVilbiss Co., Toledo, Ohio*—Series of small spray painting outfits, known as the NCB. Although the line consists of five different spray equipment assemblies, all outfits are built around a new ¼ hp. electric motor driven air compressing unit. Three are cup gun outfits and two include a pressure feed paint tank of two-gallon capacity.

*Harnischfeger Corp., Milwaukee, Wis.*—New paralleling arrangement to combine the capacities of two or more P&H-Hansen WD-150 welders. With this hook-up, an operator has at his disposal the aggregate current of two or more machines for peak loads.

*George Scherr Co., Inc., New York*—The Magne-Blox angle iron which, when placed on the plane surface of a magnetic chuck will form a magnetic right angle which gives the same holding power per square inch as the chuck itself. It consists of a series of steps measuring in width 3/16 in., ⅜ in., ½ in., 1 5/16 in., and 1⅝ in. upon which may be placed all manner of special pieces for surface grinding without the use of complicated clamps and attachments.

*Smith Welding Equipment Corp., Minneapolis, Minn.* Perfect regulation of outlet pressures, cooler, cleaner gas and complete elimination of the "hot belt" are claimed advantages for a new line of two-stage portable acetylene generators known as Type J. Available in 15, 30 and 50-lb. sizes.

*H & H Research Co., Detroit*—Reciprocating action tool with three times more power than any previous model. With a stroke length of ⅜ in. the new Series C machine develops a 30 to 40-lb. push or pull at the end of the chuck and may be used to file, burr, hone, snag, polish, saw and chip. Under full load it travels at 1250 to 1400 strokes per minute and will handle a ¾ in. square hone on heavy work and a 7/16 in. one on lighter work and confined places.

*The Standard Electrical Tool Co., Cincinnati, Ohio*—Speed lathe developed especially for production service on small parts requiring polishing, counter-sinking, reaming, burring and filing. Construction of the machine incorporates a clutch and brake unit, eliminating starting and stopping the motor whenever it is necessary to stop the work spindle. Available at any spindle speed from 150 to 3450 r.p.m.

*L. F. Kaufman Mfg. Co., Manitowoc, Wis.*—No. 5-A Hi-Duty tapping machine with a No. 40 index and eight-station chuck style dial arranged to hold circular pieces for tapping. All operations performed with air pressure, including the indexing, locking and clamping of parts.—H.E.B., Jr.

## Publications Available on Machine Tools and Equipment

Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio, has issued two new publications; one describes the company's No. 2 **centerless grinder** and the other covers **balancing arbors and stands** for the complete line of Cincinnati grinding machines.*

The Verson Allsteel Press Co.'s line of **junior press brakes** for forming, bending, coping, notching and multiple punching is described in bulletin No. JPB40.* Two new specification sheets have been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. One sheet covers the No. 10 **end mill grinding attachment** for the B&S No. 10 cutter and tool grinding machine, the other describes the No. 13 end mill grinding attachment for the B&S No. 13 universal and tool grinding machine.*

**Palmgren angle and production vises** are the subject of a leaflet issued by the Chicago Tool & Engineering Co., Chicago. Another publication prepared recently by the same company deals with **Palmgren chucks.***

A chart prepared by the Lincoln Electric Co., Cleveland, Ohio, gives uses, physical characteristics, etc., as well as currents and procedures for some 36 different **arc welding electrodes.***

Arens Controls, Inc., Chicago, has prepared a new catalog which illustrates and describes its various types of **remote controls** for aircraft, marine, radio, automotive, air conditioning, industrial and miscellaneous applications.*

**"Ace" locks** manufactured by the Chicago Lock Co., Chicago, are the subject of a new publication prepared by this company.*

**Thermocouples, thermocouple wire, lead wire, insulators, protecting tubes and their accessories** are covered in bulletin No. S2-2 published by Wheelco Instruments Co., Chicago. Two other publications recently brought out by the same company are: "High Resistance Portable Indicating Pyrometers" (No. D602-3) and "Wheelco Flame-Otrol—A Combustion Safeguard" (No. L2-2).*

A folder prepared by the Speedmaster Co., Des Plaines, Ill., describes this company's line of **variable speed pulleys.***

The National Engineering Co., Chicago, manufacturer of the Simpson Intensive Mixer, has prepared a new and well-illustrated catalog on its line of sand preparing, sand reclaiming, sand conditioning, sand control, and sand and mold handling **equipment for foundries.***

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

# Automotive MATERIALS

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VITALLY important to the success of this country's huge defense production program is the development of materials that will meet ever stiffening demands for speed and quality. Well aware of this fact, U. S. manufacturers are quietly, efficiently, improving existing materials and developing new ones in their up-to-the-minute research laboratories. Some of the latest results are reported herewith.

### *New Bessemer and Open Hearth Screw Steel*

THE Union Drawn Steel Division of Republic Steel Corp. has produced a new Bessemer screw steel and a new open hearth screw steel. The uniform fast cutting Bessemer steel, called Union Maxcut, has physical properties comparable to SAE X1112. It is said to machine equally as well or better than the highest speed Bessemer steel previously available. According to the manufacturer, parts show a smooth, fine finish when machined at 280 surface feet per minute with a basic feed of 0.0095 in. and an average tool life of more than 11 hours. The use of lighter feeds naturally permits much higher cutting speeds. Union Maxcut responds to cyaniding and other case hardening methods in a manner similar to SAE X1112.

Union Multicut, the new fast cutting open hearth steel, has physical properties similar to those of SAE 1115. Machining results are claimed to be equal or superior to those of the highest speed open hearth screw steels previously on the market. Parts show a fine finish comparable to that of Bessemer screw stock when machined at 275 surface feet per minute with a basic feed of 0.0087 in. and an average tool life better than eight hours. With lighter feeds, this steel can be run up to 350 surface feet per minute with satisfactory results. Union Multicut can be carburized and hardened to a minimum case hardness of C60 Rockwell with either single or double quench. It produces a very tough, ductile core in case hardened parts with a minimum of distortion in quenching.

### *A New Alloy for Heavy Duty Gear and Shafting Applications*

SAE 4815, a carburizing nickel-molybdenum steel, has come into prominence recently for heavy duty gear and shafting applications. In the normalized condition, its machining properties compare with SAE 4615 and SAE 2315 in respect to cutting speeds and finish. Carburizing practice is much the same as for SAE 2315. Although some shops are quenching direct, the single quench from above the core critical after slow cooling from the carburize temperature is preferred. Its distortion compares with SAE 2315 or SAE 4615.

An outstanding advantage of SAE 4815 is the high core strength which may be developed by the single quench treatment. In sections up to one inch, tensile values up to 200,000 p.s.i. and yield strengths in the neighborhood of 165,000 p.s.i. may be developed in the core together with hardnesses up to 415 B.H.N., providing excellent backing for the case under crushing loads. The tough, fine-grained case which is developed readily provides excellent resistance to wear, spalling and pitting fatigue.

The new alloy is recommended for heavy duty parts, such as gears, pinions, spindles, splined transmission shafts, pins and miscellaneous stressed parts of trucks, airplane engines, tractors, pneumatic and machine tools, oil field power transmission and drilling equipment and other similar applications. It is carried in stock by Joseph T. Ryerson & Son, Inc., Chicago, in hot rolled rounds (not annealed) in diameters ranging from ½ in. to 6 in. inclusive.

### *Soya-Bean Culture In Japan*

THE CULTIVATION of soya beans—from which plastics are made that are used extensively for body trimmings in this country—seems to be on the increase in many countries where soil and climatic conditions are favorable. In the past, Manchukuo has been the principal source of the bean and of its products. The soya is an oleaginous plant that furnishes both an oil and oil cake.

Soya-bean culture was taken up in Japan in 1927. During the fiscal year 1937-8 the total consumption of soya beans of the Japanese Empire, including Formosa and Corea, was 1,560,000 tons. Twenty-five per cent of the total was consumed by oil extractors and 50 per cent by the food industries, the bean being the raw material for certain relishes and for vegetable milk

and cheese. More and more use is made of soya flour in the manufacture of vegetable oils and of casein and certain food products. A by-product of the oil-extracting establishments is oil cake which is used as fodder. Four thousand tons are used in Japan annually in the preparation of casein glue consumed in the manufacture of laminated wood.

The oil, which is very viscous, cannot be used as Diesel fuel in its natural state, but a considerable fraction of the whole production in Japan is subjected to catalytic hydrogenation.

### *Bureau of Standards Develops Methods for Reducing Corrosion of Aircraft Metals*

METHODS for reducing corrosion of alloys used in aircraft construction have been developed by the National Bureau of Standards in cooperation with Federal aeronautical agencies and manufacturers. Some of the results achieved by the Bureau are reported in a bulletin recently released by the Department of Commerce.

This bulletin reports that corrosion of aluminum alloys was found to be either the "pitting" or "intercrystalline" types. Methods of heat treatment were developed that eliminate intercrystalline attack, while it was found that pitting can be minimized by manufacturing alloys from high-purity components, and by keeping the copper and iron contents low.

Binary magnesium-aluminum alloys were found to become more susceptible to corrosion as the aluminum content increased, but small additions of zinc or tin rendered these alloys more resistant to attack. Stainless steels of the 18 chromium-8 nickel type, containing small additions of molybdenum, were more corrosion-resistant than similar alloys without addition elements, or those with small additions of titanium or columbium.

These conclusions are based on tests of 25,000 specimens representing 60 different alloys which were corroded by accelerated methods in the laboratory or by exposure to the weather or to sea water. The exposure localities were: Washington, D. C., Hampton Roads, Va., and Coco Solo, Canal Zone.

Loss in tensile properties was used as an index of the amount of corrosion, or it was measured directly on cross-sections examined with the microscope at high magnifications.

The Standards Bureau has succeeded in developing surface coatings for both aluminum and magnesium alloys which markedly improve their resistance to corrosion under severe exposures to salt air. Important data also were obtained on the potential effects involved when alloys of different chemical compositions are exposed to corrosion in contact with each other.

### *Improved Bonding Process for Babbitt-Lined Bearings*

IN OUR issue of June 15, on page 555, we printed directions for babbitting bearing shells in such a manner as to ensure a good bond between the lining and the backing. In the process there described the surface of the backing is tin-plated before the lining alloy is applied. According to a recently-patented French process, the surface of the backing, instead of being tin-plated, is coated or "tinned" with a heterogeneous alloy whose components exhibit certain definite properties relative to the metals and alloys to be bonded, viz., steel or bronze on the one hand, and babbitt on the other. Copper-lead in the proportion of 67:33 is one such alloy, copper-thallium in the proportion of 70:30 another. The reasoning behind this new process was outlined as follows in a recent publication by Albert Portevin, noted French metallurgist.

Adherence of a metallic surface layer or coating to the base metal may be due either to mere molecular attraction, to interlocking or geometrical interpenetration of the contact surfaces, or to the formation of an alloy, that is to say, to atomic interpenetration by diffusion of the metals themselves.

Adherence by molecular attraction alone is very rare in the case of solid metals, though of common occurrence between a solid metal and a liquid metal which wets it. Between solids it is necessary to produce perfect surface contact without the least intermediate gaseous or liquid film, and without change in the surfaces. Such a contact can be obtained, for instance, between Johannsson gage blocks, but it is very hard to obtain even with electrolytic coating. For this reason it is often found expedient to try to cause interlocking of the surface coating with the base metal by roughing the surface of the latter, either mechanically, as by sand-blasting, or chemically, by means of a solution which attacks the metal.

When parts are stuck together by means of adhesives, there is at the same time molecular attraction and interlocking by penetration of the adhesive into the pores and surface irregularities of the solids.

In the case of metals, the most practical method consists in securing metallic interpenetration by the

***A New Alloy for Heavy Duty Gear and Shafting Applications . . . . Improved Bessemer and Open Hearth Screw Steels . . . . The Latest Results of Efforts to Reduce Corrosion of Aircraft Metals . . . . An Improved Bonding Process for Babbitt-Lined Bearings . . . . Soya Bean Culture in Japan . . . . A New Masking Tape***

formation of an alloy. It is this which occurs when coatings are formed by quenching a cast metal, by tinning, by electro-plating, etc., and to a still greater extent in autogenous welding, where the surfaces of both of the metals to be welded together are fused. It is even possible to obtain such an alloy in the solid state by the process of mutual diffusion, which can be accelerated by heating or by applying pressure, as in fritting.

This alloy, forming an interfacial layer ensuring a continuous joint between two metals A and B, may be either a solid solution or an intermediary phase of the A-B diagram, according to the nature of A and B and the conditions under which it was obtained. In the first case the intermediary layer is malleable, the same as the components A and B, and the adherence will continue in spite of inevitable deformation and vibration in service. The intermediary phases, on the contrary, are of a more or less metallic nature and often correspond to a brittle compound. In that case the adherence often fails in service by rupture of the interfacial layer under the effect of deformation and vibration, and perhaps even during the process of solidification after the lining has been applied.

It is this which happens in the case of anti-friction metals which, by the so-called babbitting process, are applied in thin layers (sometimes only several thousandths of an inch thick) to the bearing shells of modern combustion engines. In these engines there usually is very little clearance between the shaft and the anti-friction surface. Besides, the bond of the anti-friction metal to the backing may be poor, on account of oxidation or lack of cleanliness of the surfaces, or a rather brittle compound may be formed by the combination of the tin (or other metal) of the anti-friction alloy with the iron or copper of the bearing shell (steel-back or bronze-back bearing).

The result is that the anti-friction metal or lining does not remain in intimate contact with its backing; it chips or scales off under the effect of the applied forces.

In order to obviate these serious difficulties, it is possible to interpose between the two metals A and B (here the bearing lining and the bearing backing) a metal or alloy C, which is capable of forming an interfacial solid solution with both of the metals A and B and which will serve as a bonding agent between them. Now, it is known that A and B will both form solid solutions with C only if they form solid solutions between them, which does not hold in the case of babbitt alloys. It is therefore very likely that no metal C which satisfies the requirements can be found. On the other hand, if for C we take a homogeneous alloy or a solid solution of two metals of which one will form an alloy with A and the other with B, then the chances are good that they will both form compounds with A and B, inasmuch as the two latter also will form solid solutions.

This general problem, which is of the highest importance in the case of bearing linings, has received an ingenious solution that has been patented by the Société d'Electro-Chimie et d'Electro-Metallurgie. The bearing backing is "tinned" with a heterogeneous alloy formed of two metals in such proportion as to be non-miscible in the liquid state, such as copper and lead (one-third lead, for example). With this alloy, particles of lead are disseminated in the copper, and the two metals respectively form solid solutions with the two metals A and B—the copper with the iron or bronze, and the lead with the anti-friction alloy. The latter is thus retained by the "sealing" effect of the lead enchased in the copper, which on its part adheres to the iron by alloying. In this way there is obtained a combination of adherence by alloying (solid solution) and by interlocking.

A bearing lined with anti-friction metal in this manner is capable of withstanding a very severe test, which consists in flattening it out and then curving it in the reverse direction to its primitive radius (provided the lining is sufficiently thin and that no part of the bearing is curved to an excessively small radius). The lining will crack without becoming detached from the backing. It is claimed that without the interposition of the heterogeneous intermediary alloy, this test cannot be carried out satisfactorily.

### *Standardization of Petroleum Products*

AMONG the reports submitted to Committee D-2 on Petroleum Products and Lubricants at the annual meeting of the American Society for Testing Materials (Atlantic City, N. J., June 24-28) was one on a new method of calculating the viscosity index of an oil. Tables and equations are included in the report which make it possible to calculate the index from the viscosities at 100 and 210 deg. Fahr.

In connection with work being done on tests for the aniline point, the committee in charge had prepared a proposed method of test which was published as information only. No action has been taken as yet to refer it to the Society for approval.

In 1938 the report of this committee included proposed methods of test for ignition quality of Diesel fuels and a classification of Diesel fuel oils. Since then revisions have been made and these two items were again published as information.

A number of other recommendations by Committee D-2 were approved, including revisions of some nine standards and tentative standards, these being listed in the committee's report.

### *A New Type of Masking Tape*

A NEW type of masking tape which carries the trade-name of Scotch Wetordry is being manufactured by the Minnesota Mining & Mfg. Co., St. Paul, Minn.

The company lists the following advantages for its product: No sweating—a uniform adhesive tackiness is maintained regardless of weather; dead stretch—a new feature which eliminates curl-back and gives smooth application to curves; more flexible—easier application to curves; thinner construction—especially desirable for two-tone masking inasmuch as it reduces the pile-up at the lap of colors; strong backing—in spite of thinness, strength of backing is maintained; adhesive—the correct amount for efficient use on chrome trim, upholstery, paper aprons or for regular repaint work.

# ALFA ROMEO AG6M ENGINE

## *used on 100 passenger single-deck bus*

***Transverse section***
***See longitudinal section on next page***

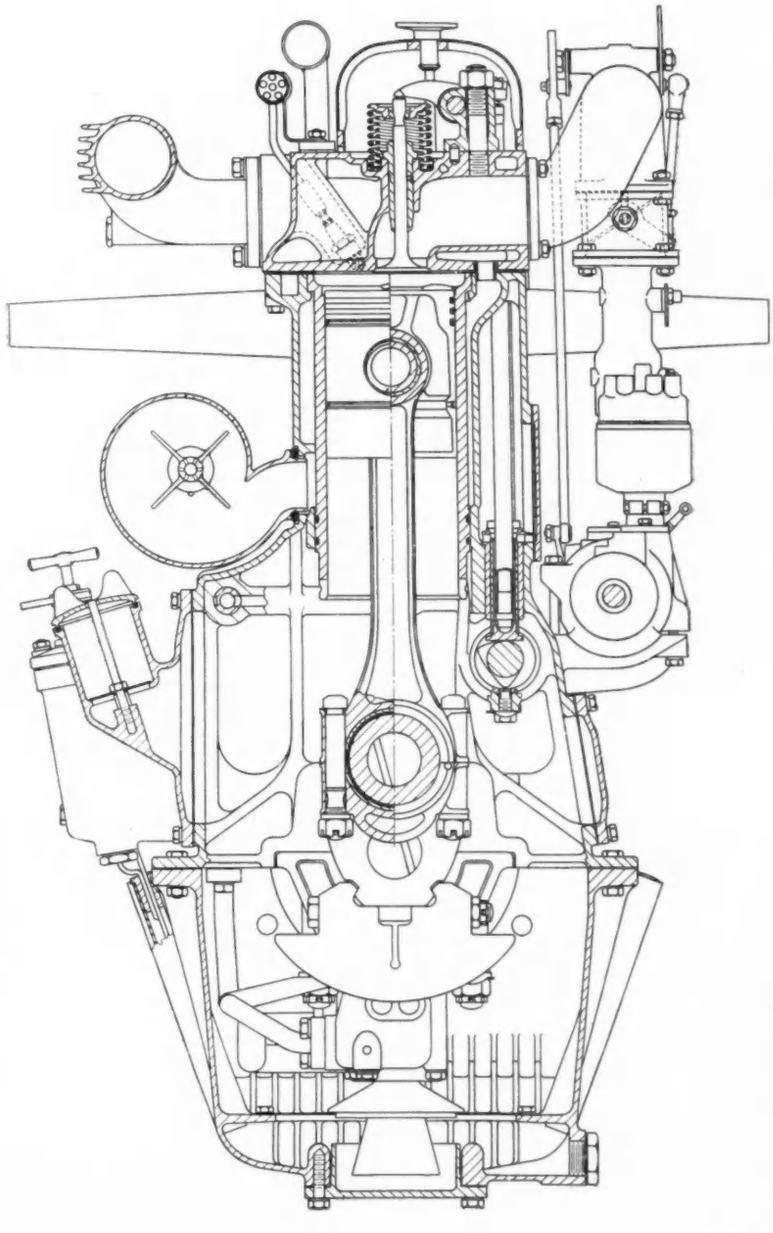
The Alfa Romeo engine, of which sectional views are shown herewith, is designed to be operated on methane gas, carried under pressure in metal containers, and is used on six-wheeled, single-deck, 100-passenger buses in service in Milan. It is a six-in-line of 4.72 in. bore and 6.69 in. stroke, with a compression ratio of 10 and a maximum output of 160 hp., though in service the output is limited to 125 hp. at 1600 r.p.m.

The cylinders are a single iron casting with removable iron liners, while the heads are cast in groups of three. The valves, which are in the cylinder heads, have diameters of 2.30 in. for the intake and 2.12 in. for the exhaust, and they are operated through pushrods and rockers. The chrome - molybdenum - steel crankshaft is carried in seven lead-bronze bearings of 3.50 in. diameter and 2.16-in. length each. Note that the camshaft gearing is located at the flywheel end. The I-section connecting rods are of chromium steel, 14⅜ in. between centers, and have 3.34 by 2.36-in. big-end bearings. Light-alloy pistons are used, with three compression and two scraper rings each.

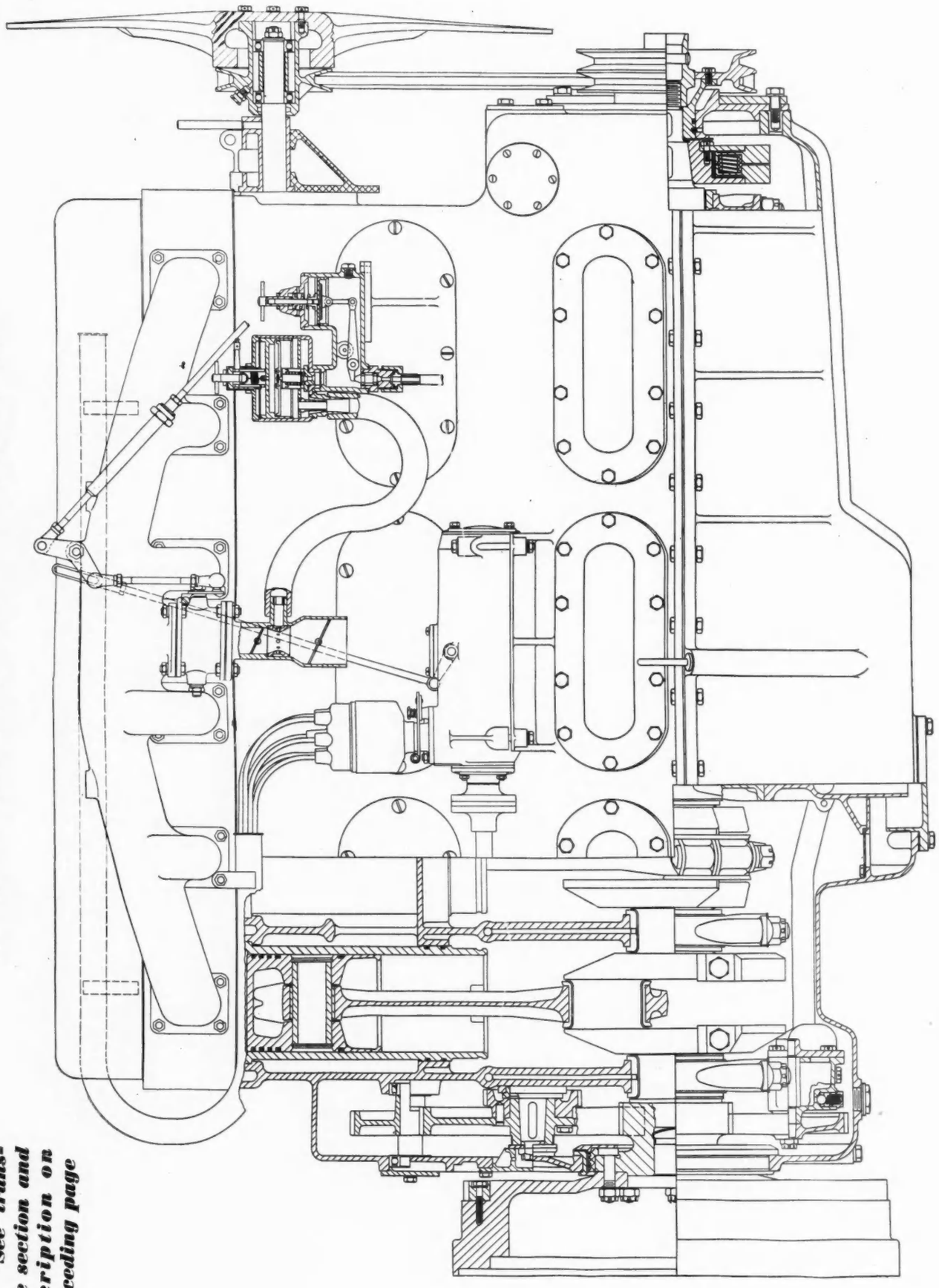
The feature of the engine is the provision for the use of methane gas as fuel. On the outside of each bus frame member, between the steering wheels and the forward ones of the two pairs of driving wheels, there is a container of chrome-molybdenum steel, the two tanks together having a capacity of a little over 30 cu. ft. The gas is stored in these tanks at about 3700 lb. per sq. in., and the supply is said to give the bus a radius of action of 250 miles at full load under city conditions. From the steel bottles the gas passes through metal pipes to a high-pressure reducing valve, which admits it to a chamber at about 30 lb. per sq. in. After passing a low-pressure valve, which is actuated by the engine suction through a regulating piston and two levers, the gas passes through a rubber hose to the mixer. It will be seen from the drawing that this contains the usual throttle valve as well as an air throttle or choke.

The specific consumption of methane is given as 0.38 lb. per hp.-hr., costing 0.50 lira, as compared with 0.54 lb. of gasoline per hp.-hr. the cost of which in Italy is 1.74 lira.

The weight of the two bottles used on the Milan buses is 1980 lb. One hundred buses are in service, also 100 trucks which can operate without imported fuel.



# ALFA ROMEO AG6M ENGINE



*Longitudinal section. See transverse section and description on preceding page*

# Design of High Speed, Two-Stroke Engines

By Scipione Treves, D.Sc., Mech. Eng.*

## Section Two

***In this section the author discusses the fundamental equation of the exhaust period. Section one appeared in the July 1, 1940, issue***

Among the various calculations which must be made when designing a two-stroke engine, the most important one—inasmuch as upon it depends the performance of the engine, and especially its power output—is that of the proper dimensions for the inlet and exhaust ports. This is followed by a study of pressure variations in the engine cylinder during the exhaust and scavening periods.

In explosion engines of both the two- and four-stroke types, the exhaust period divides into two parts, each of which has its own characteristics: First comes the pressure-equalization period, during which the pressure of the burnt gases—which at the end of the expansion period may be quite high—is reduced to one absolute atmosphere (14.7 lb. per sq. in.). Then follows the gas-expelling period (overlapping the scavenging period) during which the residual burnt gas in the cylinder is forced out. Now, while in four-stroke engines there is always more than sufficient time for the equalization of pressures, and the second part of the exhaust period therefore is of chief importance and determines the design of the exhaust valves, in two-stroke engines it is necessary to complete the pressure equalization as rapidly as possible, in order to leave enough time for the succeeding period of gas expulsion and scavening. Therefore, contrary to what applies to the four-stroke engine, the port or valve gear must be proportioned to meet the requirements of the first period, which is substantially an outlet period, and phenomena during this period will be investigated on the basis of the laws of the flow of gases from orifices.

In making this study, no account will be taken of the forces of inertia due to the acceleration of the gases, which amounts to saying that we assume the laws of steady motion to apply. This assumption may be justified by the small values of these inertia forces and by the fact that they depend on the actual dimensions of the inlet and exhaust pipes and could be determined as functions of these dimensions only by complicated and uncertain calculations.

In order to form a precise conception of what takes place during the first phase of the exhaust period, it will be well to write down the fundamental differential equation for this phase, which is obtained by equating the mass of burnt gases discharged from the exhaust ports to the corresponding reduction in the mass of gases contained in the cylinder. Using conventional symbols we shall designate by

$p$, $v$, $\gamma$, $T$, the pressures, the specific volumes, the specific masses and the absolute temperatures;

$G$ and $V$, the mass and volume of gases contained in the cylinder;

$w$ the velocity of outflow of gases through the ports;

$d$ and $c$, the bore and stroke of the engine;

$F$, the total area of the free (uncovered) portion of the port at any given moment.

We shall use the sign $'$ and the index $^\circ$ in connection with the variables to indicate that they refer, respectively, to the moment when exhaust begins and to space outside the cylinder. These signs will be omitted from the variables when they refer to conditions inside the cylinder at a given instant of the pressure-equalization period, and the index $k$ will be used where the physical state of the gases in the exhaust port is referred to. We thus arrive at the equation

$$-dG = \mu w_k \gamma_k F\, dt \quad \ldots\ldots\ldots \quad (1)$$

where $\mu$ is the coefficient of efflux according to Zeuner, who takes into account the contraction of the fluid jet. The value of this coefficient depends chiefly on the perfection attained in rounding off the inner edges of the ports (at the cylinder bore). Then, since

$$G = \gamma V,$$

equation (1) may also be written in the form

$$\frac{dG}{G} + \frac{\mu w_k \gamma_k F\, dt}{\gamma V} = 0,$$

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ENGINE DESIGN

from which by multiplying and dividing the second term by $dV$ and representing the linear speed of the piston by $u$, we get

$$\frac{dG}{G} + \frac{\mu\, w_k\, \gamma_k}{\gamma} \frac{F}{\pi \frac{d^2}{4} u} \frac{dV}{V} = 0 \quad . \quad . \quad . \quad . \quad (2)$$

We learn from general thermodynamics that in considering flow phenomena we must distinguish between two cases, according to whether the ratio of pressures ahead of and beyond the port is greater or less than the critical value

$$\frac{p}{p_k} = \left(\frac{n+1}{2}\right)^{\frac{n}{n-1}}$$

where $n$ is the exponent of the polytropic expansion formula representing the flow.* In the first case the pressure in the outlet port is the critical pressure

$$p_k = p\left(\frac{2}{n+1}\right)^{\frac{n-1}{n}} > p_o$$

while in the second case it is equal to $p_o$. In the present case, referring (as we always do in this analysis) to a two-stroke double-piston engine of high efficiency and very high angular speed, experimental data based on the observation of similar phenomena justifies the assumption that the outflow corresponds to a line not unlike the adiabatic, so that we may write

$$n = 1.30 : 1.35^{**}$$

In this way the friction between the gaseous current and the walls is sufficiently accounted for.

We will then have a critical speed in the outlet port whenever

$$p > 1.83\, p_o - 1.86\, p_o.$$

On the other hand, in the case of a supercharged engine of the type we are investigating, at the beginning of the exhaust period we will have a very high pressure, sometimes as high as 8 to 10 absolute atmospheres, as will be shown later by means of indicator diagrams. Moreover, the pressure-equalization period practically ceases, or at least is radically changed, as soon as the pressure of the burnt gases drops to that of the supercharger, which generally amounts to 1.4-1.5 absolute atmospheres, because at that moment the inlet ports must open for the scavenging and charging operation. From this it will be seen that during the greater part of the pressure-equalization period

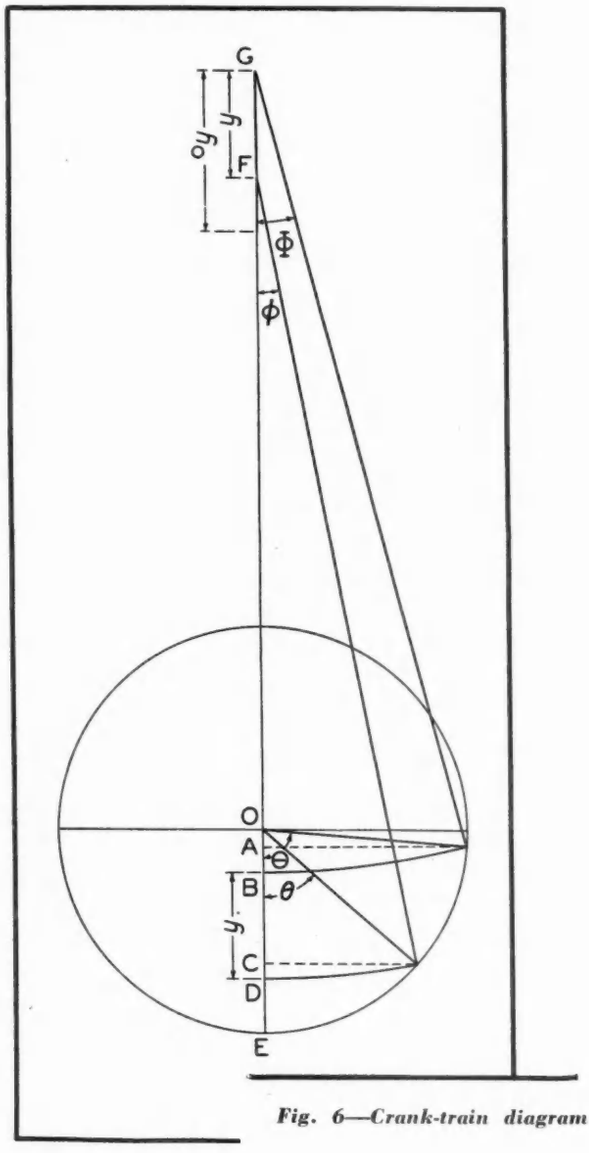



*Fig. 6—Crank-train diagram*

critical conditions must be assumed to exist in the port, and when solving equation (2), $w_k$ must be replaced by its well-known equivalent.

$$w_k = \sqrt{2g\frac{n}{n+1}pv} = \sqrt{2g\frac{n}{n+1}RT}$$

ft. per second, where $g$ is the acceleration of gravity (32.2 ft. per second$^2$) and $R$ (=53.3) is the familiar gas constant.*** Finally, it should be pointed out that the expression appearing in the second term of equation (2) also is a constant, its value being

$$\frac{\gamma_k}{\gamma} = \left(\frac{p}{p_k}\right)^{-\frac{1}{n}} = \left(\frac{n+1}{2}\right)^{-\frac{1}{n-1}} = \left(\frac{2}{n+1}\right)^{\frac{1}{n-1}}$$

****As to the area $F$ of the ports, if we confine ourselves to the usual case of rectangular ports and denote by $h$ the variable height of that part of the port which has been uncovered by the piston, and by $b$ the width

*See A. Stodola, Dampf und Gas-Turbinen, Second French Edition, Dunod, 1925, Vol. 1, pp. 33 and 39. W. Schule, Technische Thermodynamik, Fourth Edition, J. Springer, Berlin, 1923.

**A similar line represents the state of the variable quantity of fluid remaining in the cylinder. In fact, if at any given instant of the pressure-equalization period a mass—dG fluid leaves the cylinder, an amount of work —p v dG is done upon it by the remaining gas, and the gas remaining in the cylinder will, in addition, do external work to the amount of p dV proportional to the increase in volume of the cylinder itself. Hence, if U is the total internal thermal energy, the quantity of heat transmitted during the time dt to the burnt gases contained in the cylinder will be

$$dQ = G\, dU + A\, p\, dV - A\, p\, v\, dG$$
$$= G\,(dU + A\, p\, dv),$$

as will be seen from the consideration that

$$V = G\, v,$$

and, therefore,

$$dV = G\, dv + v\, dG.$$

It follows that the heat transmitted to a unit mass of burnt gases and the expansion in the cylinder are connected by the same equation, which represents a reversible cycle of a constant mass of fluid. If, for instance, no heat were transmitted to the burnt gases, they would expand in the cylinder according to the familiar law

$$p\, v^k = \text{constant},$$

which represents adiabatic expansion of gases.

***It would, moreover, be quite easy to introduce, in place of this value of $w_k$, the one corresponding to flow under small pressure differences, if it should be thought desirable to investigate that case also.

****See A. Stodola, Dampf und Gas-Turbinen, Vol. I, p. 33.

measured circumferentially at the cylinder bore, we find

$$F = b\,h.$$

Further, if we denote by $\theta$ the exhaust angle, that is, the angle made by the crank radius when the crank is in the position where exhaust begins, with the crank radius in bottom dead center, we have (Fig. 6)

$$\begin{aligned} h &= (EA - AB) - (EC - CD) \\ &= (OE - OA) - (GB - GA) - (OE - OC) + (FD - FC) \\ &= (r - r\cos\Theta - (l - l\cos\Phi) - (r - r\cos\theta) + (l - l\cos\varphi) \\ &= r\,(\cos\theta - \cos\Theta) - l\,(\cos\varphi - \cos\Phi) \quad . \quad . \quad . \quad . \quad . \quad . \quad (4) \end{aligned}$$

where $r$ $(=c/2)$ is the crank radius; $l$, the length of the connecting rod and $\varphi$ and $\Phi$ are the angles of inclination of the connecting rod corresponding to $\theta$ and $\Theta$ respectively.

It will be realized that in order to avoid excessive complication in the integration of equation (1) and its equivalent, equation (2), and to arrive at a result which lends itself to practical application, it will be necessary to introduce appropriate simplications in the expressions for the variables there considered. To be more specific, we will, in the first place, assume that $w_k$ is constant. Considering the short time during which the pressure equalization takes place, this assumption does not result in any appreciable error. This is particularly true because the only variable $T$ appears under the radical sign and any error in its evaluation therefore is of less importance in determining $w_k$. Besides, in equation (3) we can replace the initial value $T'$ (which is known, because the values of $p'$ and $v'$ at the end of the expansion period are known from the indicator diagram) by a mean value $T$ smaller than $T'$, which may generally be assumed to lie between 1800 and 2150 degs. $R$, the higher temperature naturally occuring in engines with higher compression ratios. Besides, when the calculation is completed and the pressure $p''$ at the end of the pressure-equalization period has been calculated, we will be able, by a comparison of the value assumed for $T$ with the value

$$\frac{1}{2}\left(T' + T''\right) = \frac{1}{2}\,T'\left[1 + \left(\frac{p''}{p'}\right)^{\frac{n-1}{n}}\right],$$

to judge the degree of accuracy in the assumption of $T$, and if it is considered necessary, a different value of the absolute temperature may be assumed and the calculation made over.

In the second place, we assume that the connecting rod is of infinite length, which assumption also will not result in any appreciable error, provided that in applying the final equation connecting the factors $G$, $V$ and $p$ with the variable, we take the precaution of making the various positions of the piston correspond to the values of $\theta$ obtained by making the connecting-rod length infinite. We then have

$$u = r\,\omega\sin\theta = r\,\frac{\pi N}{30}\sin\theta,$$

where $\omega$ is the angular speed of the engine and $N$ the number of revolutions per minute. Moreover, equation (4) is reduced to the simple form

$$h = r\,(\cos\theta - \cos\Theta),$$

from which we have at once

$$F = F_o\,\frac{\cos\theta - \cos\Theta}{1 - \cos\Theta},$$

$F_o$ being the total uncovered area of the ports when the crank reaches bottom dead center. It should be pointed out here that since the piston head is often convex (see Fig. 7) there is a consequent reduction in the area of the ports which is proportional to the angle of inclination of the outer portion of the piston head with respect to a plane perpendicular to the axis of the piston. If this inclination is 30 deg., for instance, in place of $F_o$ we should have

$$F_o\cos 30\text{ deg.} = 0.866\,F_o.$$

This correction, however, is not made if the piston head is entirely flat. Such flat piston heads are sometimes used to influence the flow during the scavenging and exhaust periods. When the above equivalents are substituted in equation (2) the latter becomes

$$\frac{dG}{G} + \mu\sqrt{2g\,\frac{n}{n+1}\,R\,T}\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}}\frac{4}{\pi d^2}\,F_o\,\frac{\cos\theta - \cos\Theta}{1 - \cos\Theta}\,\frac{30}{\pi N r\sin\theta}\,\frac{dV}{V} = 0\,; \quad . \quad . \quad . \quad . \quad . \quad (2A)$$

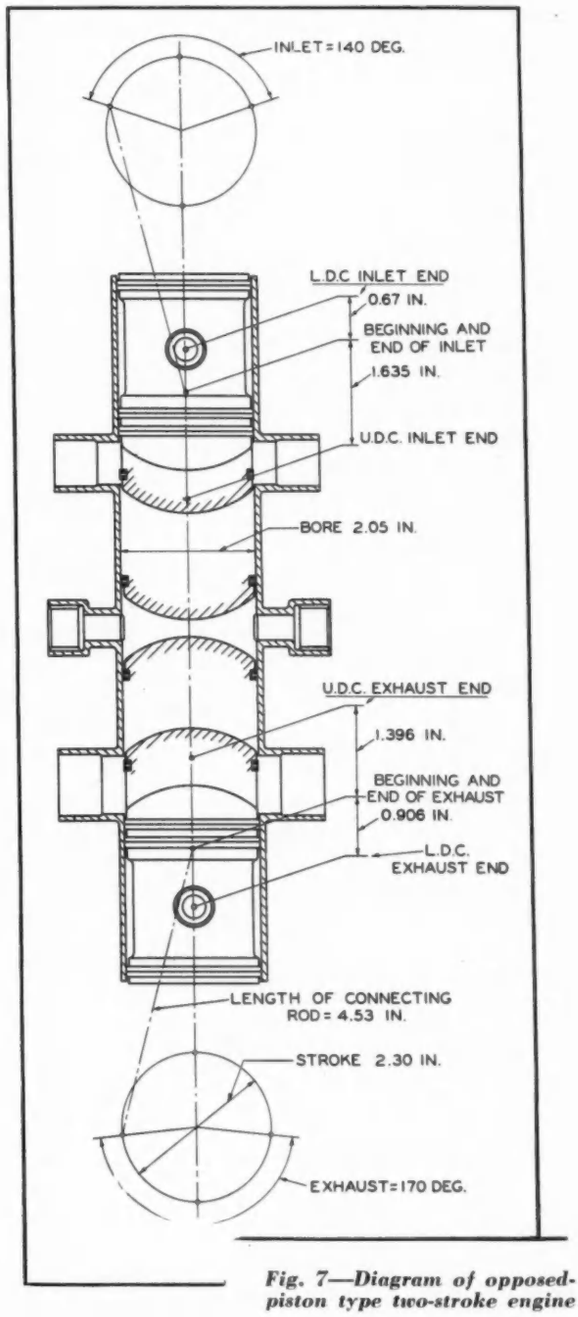



***Fig. 7—Diagram of opposed-piston type two-stroke engine***

It may also be observed that in the case under consideration (double-piston engines) if we write

$$2\,V_c = \frac{2\,\pi\,d^2}{4}\,s$$

for the compression space between the two pistons when in inner dead center, and disregard any slight lack of phase there may be between the pistons, we get

$$V = 2\,\frac{\pi\,d^2}{4}\left[s + c - r\,(1 - \cos\theta)\right]$$
$$= 2\,\frac{\pi\,d^2}{4}\,r\left(1 + \frac{s}{r} + \cos\theta\right),$$

and hence

$$\frac{dV}{V} = -\,\frac{\sin\theta}{1 + \frac{s}{r} + \cos\theta}\,d\theta\,.$$

If, in addition, we make

$$K = \mu\sqrt{2g\,\frac{n}{n+1}\,R\,T}\,\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}}\frac{4}{\pi\,d^2}F_o\,\frac{30}{\pi\,N\,r} \quad (5)$$

equation (2A) becomes simplified to

$$\frac{dG}{G} = K\,\frac{\cos\theta - \cos\Theta}{1 - \cos\Theta}\,\frac{1}{1 + \frac{s}{r} + \cos\theta}\,d\theta.$$

Integrating this differential equation with independent variables between the limits $\theta$ and $\Theta$ and observing that

$$\int\frac{\cos\theta - \cos\Theta}{1 + \frac{s}{r} + \cos\theta}\,d\theta = \theta - \left(1 + \frac{s}{r} + \cos\Theta\right)$$
$$\left[\frac{2}{\sqrt{\frac{s}{r}\left(2 + \frac{s}{r}\right)}}\,\text{arc tg}\left(\sqrt{\frac{1}{2\frac{r}{s}+1}}\,\text{tg}\,\frac{\theta}{2}\right)\right] + \text{constant.}$$

we have

$$\log\frac{G'}{G} = K\,\frac{1}{1 - \cos\Theta}\left\{\left(\Theta - \theta\right) - \left(1 + \frac{s}{r} + \cos\Theta\right)\right.$$
$$\left.\frac{2}{\sqrt{\frac{s}{r}\left(2 + \frac{s}{r}\right)}}\left[\text{arc tg}\left(\sqrt{\frac{1}{2\frac{r}{s}+1}}\,\text{tg}\,\frac{\Theta}{2}\right)\right.\right.$$
$$\left.\left. - \text{arc tg}\left(\sqrt{\frac{1}{2\frac{r}{s}+1}}\,\text{tg}\,\frac{\theta}{2}\right)\right]\right\} \quad \ldots\ldots\ldots\ldots \quad (6)$$

This indefinite integral is arrived at either by recourse to the usual methods for the integration of transcendent functions, or—more rapidly—by resolving the expression under the integral sign into two terms of the types

$$\int\frac{\cos x}{a + b\cos x}\,dx \quad \text{and} \quad \int\frac{dx}{a + b\cos x}$$

Moreover, the result may be checked immediately if we remember the well-known formula of plane trigonometry

$$2\cos^2\frac{x}{2} = 1 + \cos x$$

By means of equation (6) we can determine, for any crank or piston position, the mass of gas in the cylinder —remembering the observations made in the foregoing regarding the choice of $\theta$—because all of the factors in (6) are known except $G$, which can therefore be calculated.

From (6) we may readily determine the pressure drop in the cylinder from the beginning of exhaust to the moment corresponding to any crank angle $\theta$. To this end it is only necessary to remember that the first term of equation (6) may be written

$$\log\frac{\gamma'\,V'}{\gamma\,V} = \log\frac{\gamma'}{\gamma} + \log\frac{V'}{V}$$
$$= \frac{1}{n}\log\frac{p'}{p} + \log\frac{V'}{V}$$

Equation (6) could be materially simplified if $s$ were negligible compared with $r$, as it might be considered to be in the case of engines of very high compression ratio. In that case, repeating the mathematical work, we should arrive at the equation

$$\log\frac{G'}{G} = K\,\frac{1}{1 - \cos\Theta}\left[\left(\Theta - \theta\right)\right.$$
$$\left. - \left(1 + \cos\Theta\right)\left(\text{tg}\,\frac{\Theta}{2} - \text{tg}\,\frac{\theta}{2}\right)\right]$$

We then have

$$\frac{1}{n}\log\frac{p'}{p} + \log\frac{V'}{V} = K\,\frac{1}{1 - \cos\Theta}$$
$$\left\{\left(\Theta - \theta\right) - \left(1 + \frac{s}{r} + \cos\Theta\right)\right.\cdot$$
$$\left.\frac{2}{\sqrt{\frac{s}{r}\left(2 + \frac{s}{r}\right)}}\left[\text{arc tg}\left(\sqrt{\frac{1}{2\frac{r}{s}+1}}\,\text{tg}\,\frac{\Theta}{2}\right)\right.\right.$$
$$\left.\left. - \text{arc tg}\left(\sqrt{\frac{1}{2\frac{r}{s}+1}}\,\text{tg}\,\frac{\theta}{2}\right)\right]\right\}, \quad \ldots\ldots\ldots \quad (6A)$$

from which we get for each value of $\theta$ the corresponding value of $p$, and therefore also the pressure drop—

$$\Delta\,p = p' - p\,.$$

By means of equation (6) or (7), which, as previously mentioned, may logically be used even when taking into account the finite length of the connecting rod, we not only can trace the diagram of effective pressures in the cylinder during the first part of the exhaust period, thus determining at which angle of the (exhaust-controlling) crankshaft the inlet ports may begin to open, but it is also possible to find out without great difficulty what is the influence on the exhaust of such factors as the engine speed and the characteristic dimensions of the engine itself, viz., the stroke, bore and port area. On the contrary, an analysis of the influence of the exhaust angle $\Theta$ is much more complicated.

From the expression for factor $k$ in equation (5) the important influence of the ratio between the total free area $F_o$ of the ports and the normal section of the cylinder, $\pi d^2/4$, on the course of the exhaust period may be clearly seen; also the influence of the main piston speed, represented by $2\pi r/30$.

As to the value of $\mu$, the coefficient of efflux, it depends on the accuracy with which the inner edges of the ports are finished, as already mentioned, and in design calculations the coefficient will be assumed to have values ranging between 0.85 and 0.92. In the case of calculations relating to a cylinder already made, the average value of $\mu$ can be determined experimentally with sufficient accuracy. It is only necessary to blow air through the cylinder at a known rate, with the piston held in positions corresponding to various points of the exhaust period, and to measure the resulting drop in pressure through the ports, in accordance with methods usually employed in gas dynamics.

Pressure variations in the cylinder during the scavenging period might be studied by a method similar

to that outlined in the foregoing. It would suffice to substitute for (1) the equation

$$-dG = (\mu\, w_k\, \gamma_k\, F - \mu_a\, w_{ak}\, \gamma_{ak}\, F_a)\, dt \quad \ldots\ldots\ldots \quad (7)$$

where $\mu_a$, $w_{ak}$, $\gamma_{ak}$, and $F_a$ are variables relating to the inlet ports. However, the author does not consider it worthwhile to carry through this analysis, both on account of the complicated form of the results, which do not lend themselves readily to practical application, and also because what most interests the designing engineer is not the nature of the pressure variation during the scavenging period, but rather a method of determining that particular point of the stroke when the exhaust pressure becomes equal to the blower pressure, in order that he may know what is the best crank angle for the opening of the inlet port to begin.

It is of more interest to recall another form of the fundamental differential equation (2) which may lead to important mathematical results. It is sufficient for this purpose to observe that from the equation

$$\frac{G}{G'} = \frac{V}{V'}\,\frac{v'}{v} = \frac{V}{V'}\left(\frac{p}{p'}\right)^{\frac{1}{n}} \quad \ldots\ldots \quad (8)$$

it may be deduced that

$$dG = \frac{G'}{V'}\left(\frac{p}{p'}\right)^{\frac{1}{n}}\left(dV + \frac{V}{n}\,\frac{dp}{p}\right) \quad \ldots\ldots \quad (8^1)$$

On the other hand, from equation (1) we have

$$-dG = \mu\,\frac{w_k}{v}\,\frac{\gamma_k}{\gamma}\,F\,dt$$

$$= \mu\sqrt{2\,g\,\frac{n}{n+1}\,\frac{p}{v}}\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}} F\,dt.$$

We, therefore, have the result

$$\frac{G'}{V'}\left(\frac{p}{p'}\right)^{\frac{1}{n}}\left(dV + \frac{V}{n}\,\frac{dp}{p}\right) + \mu\sqrt{2\,g\,\frac{n}{n+1}\,\frac{p}{v}}$$

$$\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}} F\,dt = 0\,; \quad \ldots\ldots\ldots \quad (9)$$

which, observing that

$$\sqrt{\frac{p}{v}} = \sqrt{\frac{p'}{v'}\,\frac{p}{p'}\,\frac{v'}{v}} = \sqrt{\frac{p'}{v'}}\left(\frac{p}{p'}\right)^{\frac{n+1}{2n}},$$

may also be expressed in the form

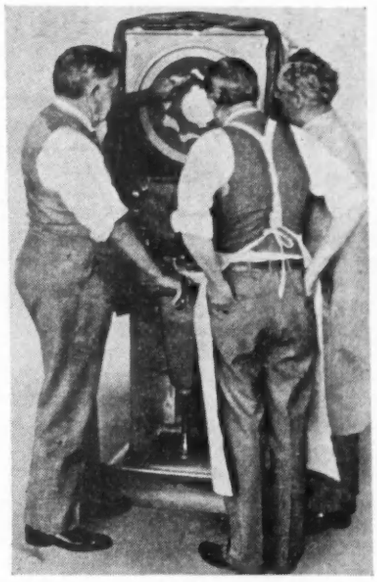
$$\frac{G'}{V'}\left(\frac{p'}{p}\right)^{\frac{n-1}{2n}}\left(dV + \frac{V}{n}\,\frac{dp}{p}\right) + \mu\sqrt{2\,g\,\frac{n}{n+1}\,\frac{p'}{v'}}$$

$$\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}} F\,dt = 0 \quad \ldots\ldots\ldots \quad (9A)$$

This differential equation between quantities $p$, $V$ and $t$, combined with the other in finite terms, makes it possible to calculate the pressure $p$ of the gases in a cylinder of displacement $V$ at any time $t$. The mass $G$ of the gases contained in the cylinder at the moment $t$ may then be obtained from equation (8).

## Enclosed Type Contour Measuring Projector

A new large enclosed type contour measuring projector has been designed by the Bausch & Lomb Optical Co., Rochester, N. Y. It is intended for use in a well lighted room and combines many new optical and mechanical features, such as the Tungsten Arc Lamp and Achromatic Condensers which produce a parallel light beam travelling vertically through the horizontal cross-slide work table, past the object to the newly developed projection lenses.

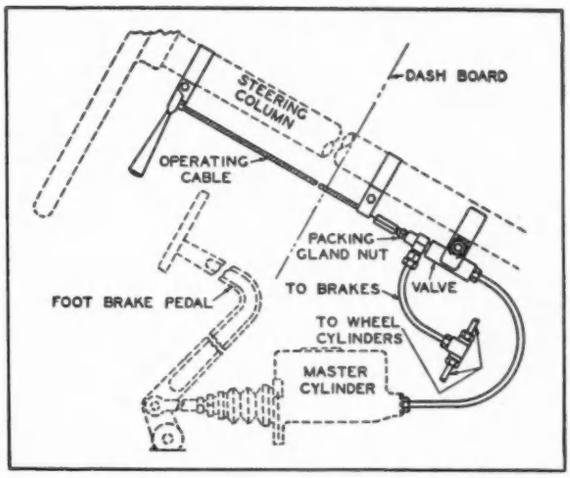


*View of the Bausch & Lomb enclosed type contour measuring projector in operation.*

Bausch & Lomb states that the image formed on the translucent screen, due to the projection lens, roof prism and two large image reflectors, is erect, unreversed, undistorted and accurate in magnifications regardless of the size of the image or its position on the screen.

## Monarch Brake-Holding Device

A device designed for installation on cars equipped with hydraulic brakes, by means of which the car can be held in position on grades by merely lifting a lever fulcrumed on the steering post underneath the steering wheel, has been developed by the Monarch Governor Company of Detroit. It consists essentially of a valve which is installed in the hydraulic line of the braking system a short distance from the master cylinder, ahead of the junction of the lines leading to the front and rear wheel cylinders. When this valve is closed the brake fluid is trapped in the wheel cylinders and the car cannot move. Release of the valve is effected by merely flicking the finger lever on the steering post, by means of a special auxiliary valve.




*Installation of Monarch Brakehold.*

# BOOKS . . . .

MACHINE SHOP TRAINING COURSE, *by Franklin D. Jones. Published by The Industrial Press, 148 Lafayette Street, New York.*

This is a work in two volumes which covers both elementary and advanced machine shop practice. It is intended for self instruction and for use in shop courses and in technical and trade schools.

The first volume begins with fundamental principles underlying all metal-cutting operations, and continues with various branches of lathe work, including single-point tool forms and tool grinding; speeds and feeds; cooling and lubricating fluids; and different screw thread standards, with a complete course on screw-thread cutting. Then follow the general application of turret lathes and automatic machines belonging to the lathe family; drilling, reaming, and boring, including precision jig boring; drill grinding; the use of tolerances and allowances in interchangeable manufacture; and, finally, the various types of measuring and gaging tools, with typical applications.

The second volume deals with such subjects as tapping, thread cutting with dies, thread milling, thread grinding, and thread rolling; planing practice; milling, including the milling of irregular contours by reproducing the shape of a model; different systems of indexing; gear-cutting on milling machines; gear-cutting by generating methods featuring the basic principles; external and internal grinding; lapping, broaching, chipping, filing, and scraping; tool steels and other metal-cutting materials; and the heat-treatment of tool steels.

Mr. Jones is a well-known writer on machine-shop and general mechanical subjects and the volumes under review can be recommended to those in need of information on machine shop practice. The books are well illustrated.

EXPERIMENTS ON JERK-PUMP INJECTION, BY KALMAN J. DE JUHASZ. *Bulletin No. 51, Engineering Experiment Station Series. Published by the Pennsylvania State College, State College, Pa.*

Research work with respect to fuel injection in Diesel engines has been carried out at the Pennsylvania State College for quite some time, and a number of bulletins dealing with it have been published in the past. Most of the previous work dealt with the distribution of the fuel in the spray cone. The investigation covered in the bulletin under review related to the fuel delivery with relation to time. It had for its object an exploration of the effects of variations of the elements inherent in systems having separated pumps and injection nozzles; i.e., the influence of pipes of various lengths and diameters, enclosed volumes, and included masses, on the timing and duration of injection. The subject is dealt with in the bulletin under the following headings: Theory of the Injection Process, Description of the Testing Equipment Used in the Present Investigation, and Experimental Results. In an Appendix various experimental methods proposed or used are critically surveyed.

*Proceedings of the Ninth Annual Meeting of the Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, D. C. Edited by Roy W. Crum.*

This publication contains all of the papers presented at the Research Board's annual meeting held at Washington, D. C., Dec. 5-8, 1939. These papers deal with the financing, the economics and the design of public highways, with soils, materials of construction, maintenance, traffic and safety. Among contributions of automotive interest are a paper on Automobile Operating Costs, by R. A. Moyer; a paper on Effect of Traffic Delays on Gasoline Consumption, by A. J. Bone, and a report on the Anti-Skid Properties of Road Surfaces.

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE. *Sixth Edition. Published by the Lincoln Electric Co., Cleveland, Ohio.*

The handbook has been reissued to include all new data essential for most efficient use of arc welding in all its varied applications. The new edition contains the results of two years of fact-finding by a staff of 200 arc welding application engineers contacting every industry throughout the world.

Eight sections of the 1125-page book cover the following subjects: Part 1—Welding Methods and Equipment; Part 2—Technique of Welding; Part III—Procedures, Speeds and Costs for Welding Mild Steel; Part IV—Structure and Properties of Weld Metal; Part V—Weldability of Metals; Part VI — Designing for Arc Welded Steel Construction of Machinery; Part VII—Designing for Arc Welded Structures; Part VIII — Typical Applications of Arc Welding in Manufacturing, Construction and Maintenance.

Copies will be mailed, postpaid, to any address in the United States for $1.50 each; outside U.S.A., $2.00.

VIBRATION OF RAIL AND ROAD VEHICLES, *by B. S. Cain, Transportation Engineering Department, General Electric Company, Published by Pitman Publishing Corp., New York, N. Y.*

In the automobile industry, increase in engine and car speeds has made it necessary to devote more and more attention to problems of vibration and its prevention, and apparently similar problems have been encountered in the railway industry, where operating speeds have also increased markedly in recent years. In the larger manufacturing organizations, vibration problems usually are assigned to engineers who have the necessary mathematical equipment to handle them, and who specialize in the subject more or less. Men who wish to qualify themselves for such work will find some useful information in this volume by Mr. Cain, which presents the basic principles underlying vibration formula in simple language. It does not stop there, however, but passes on to more advanced methods and explains their application to problems calling for them.

The book is divided into four parts. These deal respectively with general vibration theory, and vibration of automobiles, street cars, and railway vehicles. However, the section on vibration in automobiles is rather limited in scope and covers only 30 of the total of 258 pages. It deals with static and dynamic measurements of factors affecting the riding qualities, spring suspension and weight distribution, shimmy, and engine mounting. Simple experimental methods are given for the determination of the center of gravity and the moment of inertia of the vehicle, of spring flexibility, frame and body stiffness, natural rate of body vibration, and shock-absorber damping. Treatment of the remaining automobile topics, viz., spring suspension and weight distribution, shimmy, and engine mounting, is rather brief, and there is nothing in the book on vibrations due to forces arising within the mechanism itself, such as crankshaft torsional vibration, resonant flexural vibration of the crankshaft and crankcase, whirling of the propeller shaft, etc. A commendable feature of this section is that the mathematics employed is quite simple.

# Seek Greater Centralization of Defense Purchasing Authority

## *D. M. Nelson Named Purchasing Coordinator Under Nat'l Defense Advisory Commission*

A move in the direction of greater centralization of defense purchasing authority was made by the White House when Donald M. Nelson, former vice-president of Sears-Roebuck & Co. and administration adviser in various capacities since NRA days, was designated as purchasing coordinator under the National Defense Advisory Commission. While the development was interpreted as tending to broaden the commission's authority, the announced plans called for retention of the War and Navy Department's buying power subject only to such coordination as may be found necessary to establish priorities.

President Roosevelt named Mr. Nelson after a report had been made by a four-man committee designated to study the question of centralizing government defense purchasing. The committee members included Edward R. Stettinius, Jr., member of the defense advisory commission in charge of raw materials; Rear Admiral Ray Spear of the Navy Department; Brig. Gen. C. T. Harris, assistant chief of ordnance, War Department; and Mr. Nelson.

The committee recommended (1) coordination of purchases to avoid competition between federal agencies and competition for the output of the same manufacturing facilities; (2) compilation of present and future material requirements of all federal agencies; (3) aid in the application of priorities when requirements exceed resources; (4) assignment of purchase function to the agency best qualified to perform; (5) and the elimination of delays in purchasing through the enactment of corrective legislation.

If Mr. Roosevelt accepts the recommendations made by the committee, Mr. Nelson's duties will include:

1. Determination of the most economical and effective methods of purchase of repetitive items common to several agencies and assignment of the purchase function to the agency or agencies best qualified to perform it, provided that the War and Navy Departments shall have authority for making purchases necessary for the national defense, subject to such coordination as may be required to establish priorities;

2. Collection, compilation and keeping current statistics on purchases made by any federal agency.

3. Coordination of research in procurement specifications and standardization now conducted by the different federal agencies.

4. Determination and keeping current the combined immediate material requirements of all federal agencies, and estimating of future requirements to facilitate purchases and cushion the impact of such orders on the national economy.

5. Reviewing existing laws and recommending to the President such new legislation and simplification of existing legislation as may be necessary to make government purchasing more efficient and effective.

6. Investigating the necessity for making recommendations to the President relative to granting priority to orders for material essential to the national defense over deliveries for private account or for export.

That the advisory commission or some similar agency will eventually take all government purchasing under its wing is expected if and when this country goes on a war footing. Such centralizing purchasing authority was vested in the powerful War Industries Board during the World War days.

The plan to centralize government purchasing is not a new one to the New Deal. Soon after it took office, the Administration conceived the idea of establishing the Procurement Division whose job was to do all non-military

(*Turn to page 90, please*)

## *The Brass-Hat Rack*


***"Boy, is this fun! I get all the parts manufacturers on the line and say—'You'll have to cut three cents per unit!'—then I let 'em go!!"***

Acme

**Agreeing**

**Officials of General Motors Corp. and the UAW-CIO at the recent signing of an agreement providing an estimated $12,000,000 in vacation pay and wage increases and an unpire system for arbitrating grievances. At the signing were (left to right) Federal Conciliator James F. Dewey; UAW president R. J. Thomas; vice-president Phillip Murray; director of GM department of UAW-CIO Walter Reuther; Chief Federal Conciliator John R. Steelman; GM vice-president F. O. Tanner; C. E. Wilson, president of GM; and J. T. Smith, general counsel for GM.**

# Elections Continue

## *UAW-CIO Now Has Ballot Rights in 58 GM Plants*

Payrolls in the automobile industry in Michigan totaled $8,876,639 weekly during May, according to the report of the State Dept. of Labor and Industry. This was an increase of 29.9 per cent over May, 1939, in line with the 32 per cent increase in May production over the same period a year ago. However, May payrolls were 8.5 per cent less than April, 1940.

Sixty-eight Michigan automobile plants employed 254,590 workers during May, a gain of 18.9 per cent over the 1939 month. In addition, 49 automobile parts establishments had 23,335 workers whose weekly payroll was $767,559.

Average weekly earnings in the automobile industry were $34.87 during May, compared to $31.83 in May, 1939, and $37.41 in April, 1940. Only three Michigan industries — machine tool, beverages and engines and machinery —had higher average weekly earnings than the automobile industry.

Employees at four more General Motors plants voted for the UAW-CIO in NLRB elections, bringing the total to 58 GM plants in which that union has won bargaining rights. The new plants and ballot results are Yellow Truck & Coach Manufacturing Co., Pontiac, 4,655 to 595; Fisher Body No. 40, Detroit, 205 to 72; Chevrolet plant, Baltimore 711 to 116, and GM Sales & Parts, Los Angeles, 18 to 4.

The new GM contract was formally signed June 24 by representatives of the union and the corporation after being ratified by 54 union locals. The vacation allowance pay provision has been extended by the corporation to hourly rated workers in all GM plants in addition to those covered by the UAW-CIO contract. This gives 40 hours' pay to each hourly rated employe with one year or more seniority. A similar provision has been granted to employes of General Motors of Canada, granting a vacation allowance equal to 2½ per cent of each employe's annual earnings.

Negotiations between GM and the UAW-AFL, which won bargaining rights in five plants in the election of April 17, began June 26 at Detroit. Among the UAW-AFL representatives was Irvan Carey, new president of the UAW-AFL, who succeeded Homer Martin when the latter resigned April 26.

In making a report on the first six months of 1940, George Addes, secretary-treasurer of the UAW-CIO, announced that the union had a membership of 303,496 as of June 1, a gain of 116,014 from December. Thirty-two new locals have been added during the period.

Judge Leland W. Carr in circuit

(*Top of next column*)

## New Passenger Car Registrations*

| | MAY 1940 | APRIL 1940 | MAY 1939 | FIVE MONTHS 1940 | FIVE MONTHS 1939 | Per Cent Change, 5 Months, 1940 over 1939 | Per Cent of Total Five Months 1940 | Per Cent of Total Five Months 1939 | SEVEN MONTHS MODEL YEAR 1940 | SEVEN MONTHS MODEL YEAR 1939 | SEVEN MONTHS MODEL YEAR Per Cent Change |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chevrolet | 86,597 | 88,615 | 63,962 | 375,956 | 272,077 | + 38.2 | 25.27 | 23.50 | 500,295 | 376,061 | + 33.0 |
| Ford | 54,205 | 55,753 | 48,395 | 243,474 | 205,854 | + 18.2 | 16.37 | 17.78 | 334,764 | 272,440 | + 23.0 |
| Plymouth | 46,303 | 46,082 | 39,361 | 193,978 | 166,340 | + 17.0 | 13.04 | 14.36 | 222,625 | 233,632 | − 4.5 |
| Buick | 26,941 | 28,181 | 20,361 | 119,838 | 89,720 | + 33.3 | 8.06 | 7.75 | 171,286 | 127,551 | + 34.1 |
| Pontiac | 23,041 | 22,633 | 16,361 | 96,716 | 67,386 | + 43.8 | 6.50 | 5.82 | 132,965 | 93,126 | + 43.0 |
| Dodge | 21,053 | 21,567 | 22,424 | 93,156 | 90,134 | + 3.2 | 6.26 | 7.78 | 106,502 | 118,203 | − 10.0 |
| Oldsmobile | 20,191 | 20,051 | 14,139 | 84,796 | 61,291 | + 38.2 | 5.70 | 5.29 | 118,373 | 86,694 | + 36.7 |
| Chrysler | 10,292 | 10,721 | 7,381 | 44,537 | 31,507 | + 41.3 | 2.99 | 2.72 | 50,415 | 42,304 | + 19.0 |
| Studebaker | 10,107 | 9,782 | 8,719 | 42,521 | 26,950 | + 58.0 | 2.86 | 2.33 | 59,684 | 36,418 | + 64.0 |
| Mercury | 8,020 | 8,623 | 6,668 | 36,824 | 25,955 | + 42.0 | 2.48 | 2.24 | 50,953 | 32,790 | + 55.2 |
| Hudson | 7,906 | 7,926 | 5,183 | 33,845 | 21,234 | + 59.2 | 2.27 | 1.83 | 50,187 | 30,641 | + 63.8 |
| Packard | 6,930 | 7,185 | 6,011 | 31,005 | 19,842 | + 56.3 | 2.08 | 1.71 | 45,832 | 28,909 | + 58.4 |
| De Soto | 6,983 | 7,255 | 5,450 | 30,799 | 23,178 | + 33.0 | 2.07 | 2.00 | 35,732 | 31,263 | + 14.1 |
| Nash | 5,151 | 5,822 | 5,452 | 24,185 | 24,037 | + 0.6 | 1.63 | 2.08 | 33,806 | 29,641 | + 14.1 |
| La Salle | 2,113 | 2,208 | 2,189 | 9,546 | 9,561 | − 0.7 | .64 | .83 | 14,748 | 14,165 | + 4.0 |
| Willys | 2,012 | 2,096 | 1,091 | 9,339 | 4,960 | + 88.0 | .63 | .43 | 13,263 | 6,882 | + 93.0 |
| Lincoln | 1,853 | 2,078 | 1,864 | 9,328 | 8,745 | + 7.0 | .63 | .76 | 13,354 | 12,107 | + 10.3 |
| Cadillac | 1,225 | 1,239 | 1,275 | 5,470 | 5,845 | − 6.1 | .37 | .50 | 8,216 | 8,501 | − 3.4 |
| Bantam | 81 | 103 | | 455 | | | .03 | | 606 | | |
| Graham | 205 | 114 | 540 | 404 | 2,011 | − 80.0 | .03 | .17 | 512 | 2,725 | − 81.0 |
| Crosley | 28 | 51 | | 228 | | | .01 | | 335 | | |
| Hupmobile | 3 | 2 | 184 | 21 | 555 | − 96.0 | | .05 | 41 | 656 | − 93.7 |
| Fiat | | 2 | | 11 | | | | | 20 | | |
| Miscellaneous | 551 | 543 | 161 | 1,203 | 831 | + 45.0 | .08 | .07 | 1,236 | 1,130 | + 8.2 |
| Total | 341,791 | 348,632 | 277,171 | 1,487,635 | 1,158,013 | + 28.6 | 100.00 | 100.00 | | | |
| Chrysler Corp. | 84,631 | 85,625 | 74,616 | 362,470 | 311,159 | + 16.7 | 24.37 | 26.87 | 415,274 | 425,402 | − 2.4 |
| Ford Motor Co. | 64,078 | 66,454 | 56,927 | 289,626 | 240,554 | + 20.4 | 19.47 | 20.77 | 399,071 | 317,337 | + 26.0 |
| General Motors Corp. | 160,108 | 162,927 | 118,287 | 692,322 | 505,880 | + 37.0 | 46.53 | 43.69 | 945,883 | 706,098 | + 33.8 |
| All Others | 32,974 | 33,626 | 27,341 | 143,217 | 100,420 | + 43.2 | 9.63 | 8.67 | 205,522 | 137,002 | + 50.0 |

* Oklahoma figures for first three months only included in this report. This state recently enacted a law which prohibited the release or publication of any new vehicle registration data so until further notice Oklahoma will not be included in these reports, but all figures will be on a comparable basis.

court at Lansing announced that a stay prohibiting payment of unemployment benefits to 23,000 Chrysler workers as an outgrowth of last fall's strike would remain in effect until the appeal period has expired. Previously, Judge Carr had upheld Referee Charles Rubinoff's decision in allowing the benefits. An expected appeal by the Chrysler Corp. will delay the case until the Michigan Supreme Court reconvenes in October.

## MEN . . . . . .

**P. W. Sloan,** for the past two years general manager and vice-president of Linn Mfg. Co., has been appointed sales manager, truck replacement department, Diesel division, General Motors Corp.

The entire plane producing facilities of Curtiss-Wright Corp. have been placed under the supervision of vice-president **B. S. Wright,** who will continue as general manager of the Curtiss Aeroplane division in Buffalo.

**G. W. Vaught,** formerly treasurer and a director of Montgomery Ward & Co., has been elected vice-president and treasurer of B. F. Goodrich Co. **V. I. Montenyohl,** treasurer of the company since 1926, has been elected a vice-president.

**Paul Garrett,** General Motors vice-president, was elected chairman of the board of the Advertising Federation of America at its recent Chicago convention.

**R. DeYoung** has been appointed assistant to the president of Goodyear Aircraft Corp., and of Goodyear Foreign Operations Inc.

Newest addition to the engineering staff of Marmon-Herrington Co. is **George H. Freers.**

(*Turn to page* 89, *please*)

### Beans

**Jiro Okada, of the Shimizu Low Temperature Research Laboratory, Tokyo, demonstrates a novel carburetor which, the inventor claims, allows soybean oil to be substituted for gasoline in ordinary gasoline engines. Soybean oil is already in use in Japan as a substitute fuel in Diesel engines. Mr. Okada, inventor in the field of liquid-air engines, holds several U. S. patents.**

# Defense Licensing System Covers Machine Tool Exports

## *Presidential Proclamation Appoints Col. Maxwell as Administrator of Set-up*

Covering practically all machine tools, together with a comprehensive list of strategic metals and other essential items, the Government applied an export licensing system on July 5 as a national defense measure. Hereafter shipment of the affected products abroad, subjected to military direction, can be entirely prohibited or curtailed.

This rigid supervision of exports was established by President Roosevelt on July 2, in a proclamation based on a provision of the May-Sheppard law. As Commander-in-Chief of the Army and Navy the President appointed as Administrator of Export Control, Lieut. Col. Russell L. Maxwell. Indicative of the authority given Colonel Maxwell is the fact that on export control he supersedes even the Secretary of State who will be instructed on what products may be exported, and the army officer is subject to the orders of the President only.

Colonel Maxwell is administering the licensing system through the State Department's Division of Control in collaboration with the Materials Production Division of the National Defense Advisory Commission. Since 1937 the Division's licensing system applied to arms, ammunition and implements of war and previously it was applied to tin plate scrap. Under the May-Sheppard Act this system is greatly broadened.

While President Roosevelt, in commenting on his May-Sheppard proclamation pointed out the difference between an embargo and the licensing system, he said that there was no doubt that the products listed in the proclamation would henceforth remain in the United States or that if licenses were granted it was the belief that shipments would be permitted only to Latin-American countries and then only after guarantee of their ultimate destination was given. It is the opinion, however, that control will not be quite so rigid as this would indicate but that shipments will be permitted to other countries if by such exports aid is given the defense of the United States.

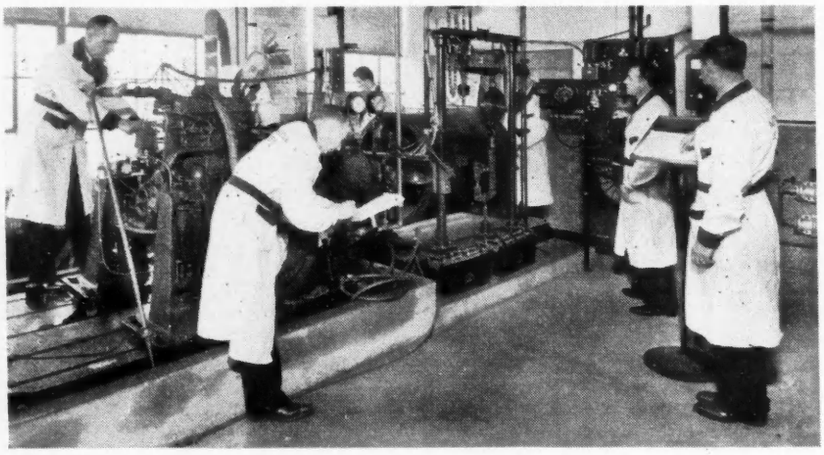
Working closely with Colonel Maxwell regarding licenses for exports of machine tools is H. B. Vance, in charge of the National Defense Advisory Commission machine tool section. In private life Mr. Vance is chairman of the board of the Studebaker Corp., South Bend, Ind. Under the Presidential proc-

(*Turn to page* 88, *please*)

## New Truck Registrations*

| | May 1940 | April 1940 | May 1939 | FIVE MONTHS 1940 | FIVE MONTHS 1939 | Per Cent Change, 5 Months 1940 over 1939 | Per Cent of Total Five Months 1940 | Per Cent of Total Five Months 1939 |
|---|---|---|---|---|---|---|---|---|
| Chevrolet | 16,589 | 19,038 | 15,565 | 84,167 | 74,125 | + 13.5 | 34.29 | 35.90 |
| Ford | 13,527 | 15,077 | 11,436 | 68,971 | 54,235 | + 27.0 | 28.09 | 26.26 |
| International | 6,615 | 6,899 | 5,259 | 31,004 | 25,366 | + 22.3 | 12.63 | 12.28 |
| Dodge | 5,401 | 5,534 | 5,111 | 24,977 | 22,478 | + 11.0 | 10.17 | 10.89 |
| G. M. C. | 4,300 | 4,001 | 3,172 | 17,624 | 13,738 | + 28.4 | 7.18 | 6.65 |
| Plymouth | 1,050 | 1,052 | 1,097 | 4,536 | 3,998 | + 13.0 | 1.85 | 1.94 |
| White | 626 | 834 | 421 | 2,934 | 1,762 | + 66.0 | 1.19 | .85 |
| Mack | 750 | 652 | 664 | 2,933 | 2,578 | + 13.8 | 1.19 | 1.25 |
| Diamond T | 496 | 560 | 425 | 2,590 | 2,016 | + 23.7 | 1.05 | .98 |
| Willys-Overland | 223 | 218 | 163 | 1,029 | 638 | + 61.2 | .42 | .31 |
| Divco | 187 | 163 | 160 | 789 | 691 | + 14.0 | .32 | .33 |
| Federal | 149 | 148 | 172 | 724 | 608 | + 19.0 | .29 | .29 |
| Autocar | 158 | 152 | 184 | 684 | 760 | − 10.0 | .28 | .37 |
| Studebaker | 111 | 133 | 195 | 584 | 870 | − 32.8 | .24 | .42 |
| Brockway | 143 | 102 | 177 | 577 | 709 | − 18.5 | .23 | .34 |
| Hudson | 91 | 90 | 42 | 373 | 224 | + 66.3 | .15 | .11 |
| Bantam | 41 | 51 | 55 | 234 | 224 | + 4.3 | .10 | .11 |
| Sterling | 25 | 35 | 45 | 137 | 140 | − 2.1 | .06 | .07 |
| F. W. D. | 23 | 13 | 12 | 125 | 73 | + 71.1 | .05 | .04 |
| Reo | 5 | 6 | 76 | 32 | 685 | − 95.3 | .01 | .33 |
| Miscellaneous | 120 | 73 | 89 | 516 | 586 | − 11.9 | .21 | .28 |
| Total | 50,630 | 54,831 | 44,520 | 245,540 | 206,504 | + 18.6 | 100.00 | 100.00 |

* Oklahoma figures for first three months only included in this report. This state recently enacted a law which prohibited the release or publication of any new vehicle registration data, so until further notice Oklahoma will not be included in these reports, but all figures will be on a comparable basis.



**Injecting Knowledge**

**American Bosch Corp., supplier of fuel injection equipment for Diesel engines, has established a school to provide an authoritative source of information on the operation application and maintenance of the equipment. The school course is open to anyone definitely connected with the Diesel industry—whether he be an engine manufacturer's technician, a school instructor or the operator of Diesel equipment. There is no charge in connection with the school and those attending need defray only their travelling and living expenses. This photo shows a group of "students" working on one of the two modern dynamometers that are available.**

# Steel Mills Begin Rolling and Finishing of 1941 Model Stock

***Pressure of Rearmament Demand on Capacity Has Not Inconvenienced Automotive Consumers***

Steel mills began rolling and finishing 1941 model body and fender stock, initial lots of which have been ordered by virtually all automobile manufacturers, immediately following the Fourth of July holiday shutdown. While steel mills generally observe Independence Day, that and Christmas being the only two traditional holidays of the industry, some units will be down a few days longer to permit reconditioning of overworked equipment. The American Iron & Steel Institute estimates the rate of this ingot production at 74.2 per cent of capacity, for the holiday week, which, considering that this was for a five-day week, denotes little change from the preceding full week's record of 86.5 per cent. Pressure of rearmament demand on capacity so far has not resulted in any inconvenience for automotive consumers. Only future developments can reveal whether balance of supply and demand can be kept on its present even keel, but there is no disposition to enlarge on what little has been done by way of protective stocking. Usually at the beginning of a new quarter, there begins also speculation as to the price set-up three months hence. For the time being this habit has been shelved. Neither steel producers nor consumers can look much further ahead these days than the next few weeks, but sellers as well as buyers appear to be confident that, barring unforeseen developments, the steel market's price structure will not be materially altered at the outset of the year's last quarter. If the steel industry of the European continent comes definitely under German sway, the indirect effect on the American market will, of course, be unavoidable, but this, it is figured, would not make itself felt until later.

To what extent the price of tin in the open market will be affected by organization under Reconstruction Finance Corporation auspices of the Metals Reserve Company, which is to buy 75,000 tons of tin at 50 cents a pound, c.i.f. New York, for a Government reserve stock, has not yet become clear. The tonnage, which, it is estimated, will take a year to accumulate, represents approximately 37½ per cent of the world's annual production, but is expected to act as an incentive to the Malayan and Dutch East Indies producers to speed up their output. The International Tin Committee is expected to increase export quotas without delay. The tin is to be for use of the Government only, but the effect of these holdings would in all probability help industrial consumers in keeping the open market price at a reasonable level. At the opening of the market, July 1, the price of spot Straits tin stood at 52¼ cents.

The copper market has felt the effect of the withdrawal of France, heretofore one of the American refiners' best customers. Producers offered spot electrolytic at 11⅛ cents, and in the outside market this could be shaded fractionally.—W. C. H.

## FTC Reported Drafting Trade Practice Rules

Despite opposition from the trade, it is reported that the Federal Trade Commission is drafting final trade practice rules for the automobile industry. Unless induced to withhold them, as has been requested, it is expected the Commission will promulgate the rules soon. The National Automobile Dealers' Association in a joint brief filed by Donald Richberg and Charles W. Bishop, counsel and general counsel respectively, as pointed out in AUTOMOTIVE INDUSTRIES of June 1, pages 529 and 532, asked the Commission to hold the rules in abeyance pending discussions between retailers and manufacturers which are designed to develop "a concrete practical program for the elimination of bad practices and unhappy conditions within the industry." Other organizations in the trade also have urged that the rules be either deferred or abandoned entirely.

Broad industry opposition developed even before the Commission promulgated its proposed rules. The Commission rejected the more important rules as originally suggested by NADA or so modified them that they became distasteful to the trade, making it regret it had ever sought rules under government supervision.

At the least the trade had expected the Commission to withhold action of the rules till fall, hoping that if an agreement were reached within the trade itself the Commission would keep hands off. The NADA told the Commission that approval of its proposed rules would hamper rather than help industry efforts to agree upon fair practices and sound contractual arrangements. Its brief detailed objections to the proposed rules.

## Truck Trailer Builders Form New Organization

The Truck Trailer Manufacturers Association was formed in a meeting held recently in Chicago to represent that industry to the public and to present a united front in all matters affecting the industry. The formation followed a series of meetings which started in Chicago early in January and meetings at New Orleans, Los Angeles and Seattle.

M. J. Neeley of Hobbs Mfg. Co., Fort Worth, Texas, was elected first president of the organization. P. H. Bartlett of Bartlett Trailer Co., Chicago, is vice-president and treasurer. Chairman of the board is Harvey C. Fruehauf, president, Fruehauf Trailer Co., Detroit, and other board members be-

sides the officers and Mr. Fruehauf are N. A. Carter of Carter Mfg. Co., Memphis; George A. Mercer, Jr., of Steel Products Co., Savannah, Ga., and Harry N. Brown of Keystone Trailer and Equipment Co., Kansas City. Lawrence H. Selz, president of the Lawrence H. Selz Organization, Chicago, is executive secretary and publicity counsel to the organization. Headquarters will be maintained in the Selz Organization headquarters at the Merchandise Mart, Chicago.

A membership campaign is now under way to secure the support of manufacturers and all supply companies.

Among other trailer manufacturers who are already members are John C. Dix and Son Co., Rogers Brothers Corp., LaCrosse Trailer and Equipment Co., Truck Equipment Co. and Carolina Truck and Trailer Co.

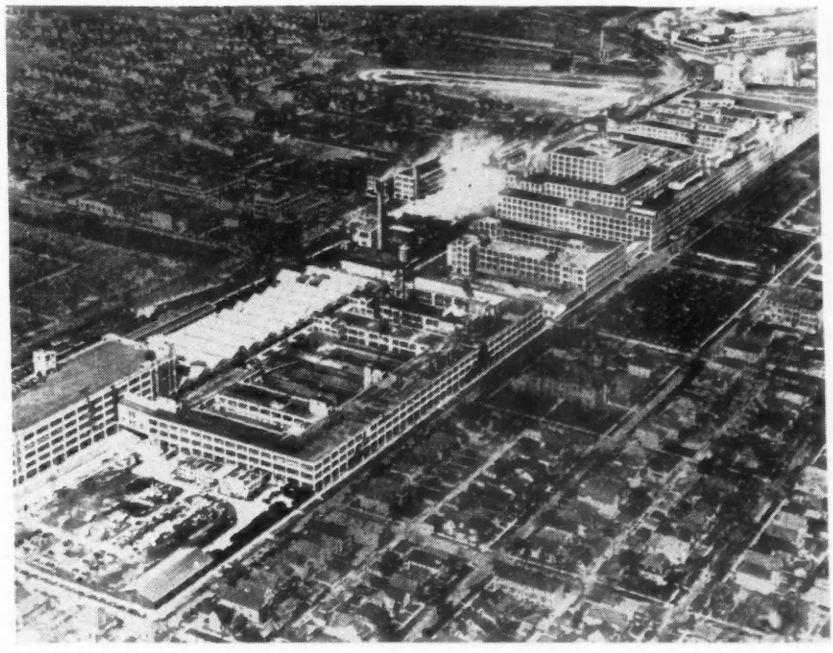
Among the suppliers who are members are Austin Trailer Co., Bendix-Westinghouse Automotive Air Brake Co., Burton Spring Co., Dayton Steel Foundry Co., Erie Malleable Iron Co., Great Lakes Steel Corp., Holland Hitch Co., Maremont Automotive Products Co., Maumee Malleable Casting Co., Tuthill Spring Co. and Youngstown Steel Car Corp.

The program of the industry calls for a concentrated editorial publicity program to teach the public the value of truck trailers to their daily lives, to work towards a unification of laws governing the movement of trailers on highways and to educate the firms shipping merchandise of the availability and efficiency of the truck trailer.

## Industry Survey Shows Car Inventory Decline

Inventories of automobiles and equipment declined to the index 98.2 in May from 108.5 in April; January, 1939, taking the index 100. The value of shipments, according to the monthly industry survey of the Bureau of Foreign and Domestic Commerce, dropped to 117.6 from 127.4.

In the absence of a suitable measure of new orders, data for the automotive industry were excluded from the index. The aircraft industry was also excluded "in order to avoid unduly influencing the index as the result of the unusual conditions prevailing in that industry."



Acme

### They May Roll Out the Rolls

**View of the Packard Motor Car Co. plant in Detroit which may be used for the production of Rolls Royce aircraft engines. In the event that the production contract is signed, some new buildings, mostly test sheds, will be added to this plant which already has 88 acres of floor space—sufficient, the company says, to handle the engine output without affecting car production.**

## Packard Contract Would Not Affect Car Output

Any manufacturing of aircraft engines will not affect the new passenger car business, M. M. Gilman, president of Packard Motor Car Co., emphasized in discussing the proposed contract between the government and the company for the production of 9000 Rolls-Royce airplane engines. Packard's board of directors met at Detroit, July 8, but did not approve the contract, issuing the following statement:

"The matter of a possible contract for the building of Rolls-Royce engines for England and the United States was discussed at a meeting of all the board of directors. The company is anxious to be of public service and is hopeful that a satisfactory agreement can be reached, but there are many matters that require further study."

Further conferences between Gilman and William S. Knudsen, production coordinator of the National Defense Commission, were anticipated. After their first conference, July 3, in Washington, Gilman said the Packard company would be able to get into production on the motors 10 months after signing of the contract, turning out 20 motors the first month and accelerating to an output of 840 engines monthly within five more months.

The contract for Rolls-Royce engines originally was offered to Ford Motor Co., but was turned down by the latter because 6000 of the engines were to be made for the British government. Gilman said he had received the finest cooperation from the Ford engineers. Although declining this order, Ford still is going forward with plans for aircraft engine production as an individual enterprise, 300 engineers and draftsmen now working at Dearborn.

The airplane engine tooling program would cost $30,000,000, Gilman estimated. It would require approximately 1,200,000 sq. ft. of factory space, which would require some new building at the Packard plant. It would employ 14,000 workers. Packard built 6500 Liberty aircraft engines over a two-year period at the time of the last World War. Further experimentation was carried on with airplane motors for some years after the war but eventually was dropped.

The Rolls-Royce Merlin engine, which Packard proposed to build, is a 12-cylinder, V-type developing 1000 to 1300 hp.

### Truck Production by Capacities

*(U. S. and Canada)*

| | FIVE MONTHS | | | Per Cent of Total | |
|---|---|---|---|---|---|
| | 1940 | 1939 | Per Cent Change | 1940 | 1939 |
| 1½ Tons and less | 332,499 | 309,910 | + 7.0 | 89.40 | 92.06 |
| 2 to 3 Tons | 22,630 | 15,174 | + 49.0 | 6.08 | 4.51 |
| 3½ Tons and over | 5,911 | 5,229 | + 13.1 | 1.59 | 1.55 |
| Special and buses | 2,848 | 2,468 | + 15.3 | .77 | .73 |
| Station Wagons | 8,049 | 3,884 | +108.0 | 2.16 | 1.15 |
| Total | 371,937 | 336,665 | + 10.4 | 100.00 | 100.00 |

# Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE INDUSTRIES**

Sustained expansion of general business activity is indicated. The seasonally adjusted index of The New York *Times* for the week ended June 22 rose to 102.8 per cent of the estimated normal, as compared with 99.3 a fortnight earlier. The unadjusted index of *The Journal of Commerce* advanced to 103.8 per cent of the 1927-29 average, as against 99.1 two weeks before and 87.6 a year ago.

Retail trade last week fell slightly below levels maintained in the preceding week, when regional sales averages were from 6 to 11 per cent. above those a year ago, according to Dun & Bradstreet estimates. Department store sales during the third week of June were 10 per cent above the corresponding 1939 total, according to the Federal Reserve compilation, as compared with a year-to-year gain of 9 per cent reported for the week before.

Production of electricity by the power and light industry during the week ended June 22 declined slightly from the three-month peak recorded in the preceding week, and the excess above the comparable output last year fell from 11.1 to 9.8 per cent.

Railway freight movement in the same period established a new 1940 peak, with the loading of 728,096 cars, 25,525 more than the number a fortnight earlier and 14 per cent greater than corresponding loadings last year.

Bank debits to other than interbank accounts in leading cities during the thirteen-week period ended June 26 were 6 per cent above the comparable amount in 1939.

Crude oil production during the final week of June declined substantially to an average of 3,639,550 barrels daily, exceeding by 19,250 barrels the required output as computed by the Bureau of Mines; the similar excess two weeks earlier was 195,900 barrels.

Engineering construction contracts awarded during the week ended June 27 dropped sharply below the year's peak recorded for the week before, according to *Engineering News-Record*. For the year to date the total is 11 per cent below the corresponding 1939 awards—a gain of 24 per cent in private work being more than offset by a drop of 23 per cent in the much larger volume of public construction.

Cotton-mill activity advanced contrary to the usual seasonal trend in the third week of June. The New York *Times* adjusted index was 137.9, as compared with 124.0 a year ago.

Business failures during the week ended June 27 numbered 286, according to the Dun & Bradstreet compilation, as compared with 296 in the week before and 264 a year ago.

Professor Fisher's index of wholesale commodity prices for the week ended June 28 declined to 82.1 per cent of the 1926 average from 82.3 for the preceding week—successive low points for the current year.

Excess reserves of the member banks of the Federal Reserve system rose $30,000,000 during the week ended June 26 to an estimated new peak of $6,800,000,000. Business loans of the reporting members increased $12,000,000 to a total of $4,399,000,000, or $566,000,000 more than the comparable amount last year.

## Willys Reports Six Month Loss

Willys-Overland Motors, Inc., has reported a net loss of $281,297, after depreciation and amortization of $444,063, taxes, interest, etc., for the six months ended March 31. This was compared with a net loss of $755,846 in the same period of 1939, after depreciation and amortization of $333,631.

## Davis & Thompson Co. Sold to Chicago Firm

Davis & Thompson Co., Milwaukee, manufacturer of automatic production machinery, has been sold to Louis E. Emerman & Co., Chicago. Frank M. Davis, president of D&M, which has been a partnership between himself and John Thompson for many years, stated that the plant was sold because both he and Mr. Thompson were "getting along in years."

Operations will be continued in Milwaukee under the same corporate name with the new owners of the firm producing machine tools for the automotive industry under patents owned by Davis.

The plant will be in charge of W. H. Weimer, who has been with D&M since 1911. He will have the title of vice president and general manager. C. L. Nelson, Chicago, will be president. Mr. Davis will become chairman of the board and will serve in an advisory capacity, while Mr. Thompson will make his retirement complete.

## Canadian Ford Expands For Military Output

Ford Motor Co. of Canada has begun work on a $700,000 expansion program at its Windsor, Ont., plant to increase facilities for the production of military equipment for the Canadian Government. An addition to the 15-acre machine shop will provide 109,440 square feet of new floor space for military production.

The addition will make available manufacturing space for machine gun carriers, which will be turned out at a rate of 50 per week, according to Wallace R. Campbell, president of the company. It also will increase manufacturing facilities for army trucks and gun tractors. Campbell pointed out that more than 50 per cent of the company's production consists of military units for the British Empire.

# CENSORED

***An exclusive feature prepared by the London correspondent of* AUTOMOTIVE INDUSTRIES, *M. W. Bourdon.***

Prices of used cars of low ratings have been increasing steadily since the early part of this year, but divergent views are expressed as to whether this trend will continue irrespective of a possible reduction in the gasoline ration or a further turn for the worse in the war situation. It is said—though the writer has thus far failed to secure confirmation—that some dealers are "hoarding" used cars of modern types in good condition, in the belief that, owing to the likelihood of an immense unsatisfied demand for new cars during the first six months or so after the end of the war, the values of used cars will soar to the same extraordinary heights they attained after the war of 1914-18.

* * *

Lord Austin, for reasons not stated, has resigned the chairmanship of the Shadow Aero Engine Factory Committee, a position he has held since its inception four years ago. In that position he has been largely responsible for co-ordinating the work of the six shadow factories built by the Government and operated by automobile manufacturers.

* * *

In the first four months of this year exports by the English Ford Motor Co. showed the following increases, among others, as compared with the same period last year: Australia, 248 per cent; India, 148 per cent; Portugal, 139 per cent; Uruguay, 55 per cent; West Indies, 44 per cent, and Argentine, 18.5 per cent. At the annual meeting of the shareholders in London, Lord Perry, the chairman, said that as soon as the Government authorised material supplies and expenditure upon machine tools, jigs, etc., the company would commence production in England of the Ford light farm tractor—Ferguson system—which had been demonstrated a few days earlier for the first time at a gathering of English farmers.

* * *

Fourteen of the Rochdale Corporation buses with Diesel engines are to be run on creosote, in addition to the six that have been using it for some months, so that the possibilities of this fuel may be further explored. Hitherto it has not been found so trouble-free as petroleum fuel oil, but dependable enough to make it worth while as a fuel to supplement the petroleum fuel ration.

# GM Files Brief

## *Asks Complaint Dismissal In Exclusive Dealer Case*

In a brief filed with the Federal Trade Commission on July 5, the General Motors Corp. and the General Motors Sales Corp. denied the FTC allegation in the so-called exclusive dealer case that General Motors dealers are required to handle GM parts exclusively, asking that the complaint be dismissed "for lack of support in fact and in law."

The brief, submitted to the FTC by John Thomas Smith of New York, attorney for the company, took exception to the Commission contention that the alleged practices constitute unfair competition or practices in violation of the Clayton anti-trust laws.

The brief emphasized that:

1. There is the widest distribution of all genuine parts and accessories through wholesale and retail outlets to the consuming public. Testimony presented at FTC hearings on the case shows that the respondents have neither engaged in the acts and practices alleged in the first count of the complaint, nor that its trade practices constitute unfair methods of competition, in respect of accessories and supplies for use on GM automobiles.

2. The Chevrolet-Oldsmobile-Pontiac-Cadillac Dealers' Agreement and the pertinent testimony at the hearings, show that the General Motors Sales Corp. and the separate companies never made sales and contracts for the sale of automobile parts with dealers on the condition, agreement and understanding that the purchasers thereof should not deal in the automobile parts of their competitors.

3. The "genuine" parts provisions and other provisions of the Buick-Cadillac-Chevrolet-Oldsmobile-Pontiac Dealers' Agreement and the testimony elicited, show that such clauses are for the protection of the automobile owner, as well as for the protection of the business and good will of the automobile manufacturer.

4. Statistics show that during the years in which the genuine parts clause has been used, competition between manufacturers instead of lessening has greatly increased, that retail outlets have multiplied and jobbing concerns have doubled in number, and the cases cited in the brief for the Commission are not in point and are not applicable in any view of the case.

The General Motors brief cited the decision in the case entitled "Federal Trade Commission vs. Sinclair Refining Co.," in which the Supreme Court said that "there is no covenant in the present contract which obligates the lessee not to sell the goods of another; and its language cannot be so construed." The situation is identical with respect to the GM dealer's agreement because of the absence of a contractual provision, the FTC was told in the brief.

## Motion Picture

**Plymouth devised this method of contrasting wheel and body motion in one picture. Driven past a camera with open lens, lights on the car's hub cap and rear quarter panel show how modern flexible springing cushions the body against jolts from the wheels passing over 2x4 timbers.**

## 40 YEARS AGO

It may reasonably be expected that the railway companies will be among the earlier patrons of the motor car. Railway managers are far too astute, and too eagerly on the watch for means to reduce working expenses, to neglect any opportunity which these cars may present of effecting economy. But the advantage they will thus gain will only be a temporary one, and they will be assisting to familiarize their clients with a formidable competitor to the iron road.

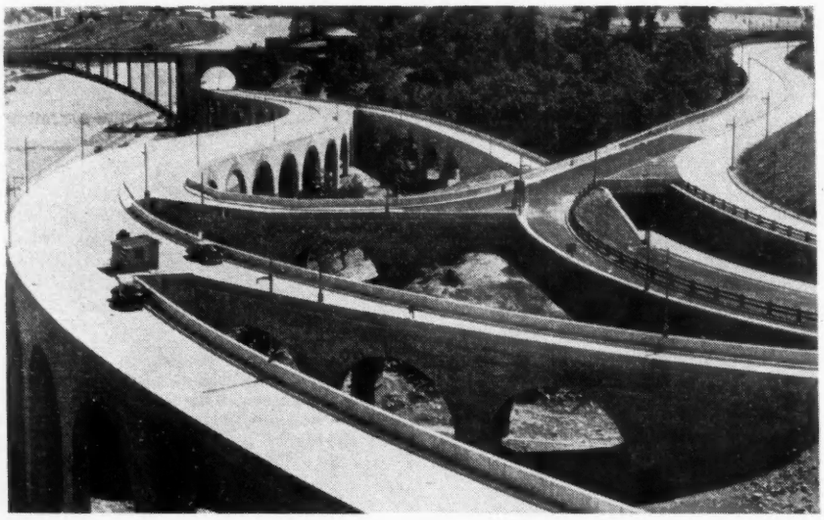
Between many of the places at present served by these lines it will be found more economical to load goods on a road carrier's motor wagon than to place them on a railway lorry for transport to the forwarding station, there to be transhipped to a rail wagon, and again transferred to a lorry for delivery on arrival at the station of destination.

The makers and users of the new cars must, therefore, watch the attitude of the railways with jealous solicitude, and be wary lest, in seeming to bless, they endeavor to hamper and destroy the new industry.

From *The Horseless Age*, July, 1900.

## Five-Month Automotive Exports & Imports

| | MAY 1940 | | MAY 1939 | | FIVE MONTHS ENDED MAY, 1940 | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1940 | | 1939 | |
| | No. | Value | No. | Value | No. | Value | No. | Value |
| **EXPORTS** | | | | | | | | |
| Automobiles, parts and accessories | | $ 21,337,197 | | $ 23,753,181 | | $ 117,472,189 | | $ 123,869,401 |
| **PASSENGER CARS** | | | | | | | | |
| Passenger cars and chassis | 9,207 | 5,843,707 | 14,317 | 8,777,802 | 51,010 | 31,663,093 | 79,325 | 48,795,513 |
| Low price range $650 inclusive | 8,180 | 4,726,288 | 12,740 | 7,188,148 | 44,992 | 25,450,110 | 70,529 | 39,531,892 |
| Medium price range over $850 to $1200 | 863 | 835,691 | 1,413 | 1,330,735 | 5,214 | 4,956,950 | 7,596 | 7,251,508 |
| $1200 to $2000 | 142 | 204,861 | 140 | 198,482 | 727 | 1,054,641 | 994 | 1,480,380 |
| Over $2000 | 22 | 76,867 | 24 | 60,437 | 77 | 221,392 | 206 | 531,733 |
| **COMMERCIAL VEHICLES** | | | | | | | | |
| Motor trucks, buses and chassis (total) | 7,832 | 6,995,465 | 10,770 | 6,470,049 | 50,450 | 41,194,877 | 53,609 | 33,151,626 |
| Under one ton | 756 | 366,614 | 1,515 | 639,835 | 6,951 | 3,161,714 | 8,175 | 3,470,550 |
| One and up to 1½ tons | 5,855 | 3,099,337 | 8,128 | 4,465,208 | 31,769 | 17,478,578 | 37,185 | 20,192,671 |
| Over 1½ tons to 2½ tons | 704 | 814,606 | 678 | 605,773 | 8,089 | 10,704,075 | 5,723 | 4,946,987 |
| Over 2½ tons | 512 | 2,701,956 | 421 | 727,808 | 3,535 | 9,688,900 | 2,152 | 4,213,223 |
| Bus chassis | 5 | 12,952 | 28 | 31,425 | 106 | 161,610 | 374 | 328,195 |
| **PARTS, ETC.** | | | | | | | | |
| Parts except engines and tires | | | | | | | | |
| Automobile unit assemblies | | 3,544,694 | | 3,598,456 | | 19,769,482 | | 18,896,047 |
| Automobile parts for replacement (n.e.s.) | | 3,513,638 | | 3,402,773 | | 17,931,578 | | 16,097,361 |
| Other automobile accessories (n.e.s.) | | 403,660 | | 356,932 | | 1,980,641 | | 1,607,595 |
| Automobile service appliances | 1,628 | 370,239 | 1,983 | 551,470 | 4,563 | 1,758,786 | 8,618 | 2,610,851 |
| Airplanes, seaplanes and other aircraft | 295 | 13,998,832 | 156 | 6,909,332 | 1,090 | 71,556,235 | 583 | 24,088,082 |
| Parts of airplanes, except engines and tires | | 22,590,110 | | 10,385,338 | | 110,796,758 | | 38,249,052 |
| **INTERNAL COMBUSTION ENGINES** | | | | | | | | |
| Stationary and Portable | | | | | | | | |
| Diesel and semi-Diesel | 74 | 368,677 | 55 | 354,559 | 389 | 1,279,477 | 190 | 768,292 |
| Other stationary and portable | | | | | | | | |
| Not over 10 hp. | 1,208 | 68,092 | 1,330 | 86,834 | 6,557 | 380,569 | 5,652 | 334,786 |
| Over 10 hp. | 187 | 260,079 | 76 | 49,520 | 1,057 | 1,362,764 | 573 | 415,063 |
| Engines for: | | | | | | | | |
| Motor trucks and buses | 1,715 | 207,955 | 2,538 | 314,675 | 10,161 | 1,118,013 | 12,346 | 1,473,194 |
| Passenger cars | 862 | 80,840 | 2,773 | 249,113 | 9,543 | 862,452 | 13,596 | 1,279,860 |
| Aircraft | 397 | 3,408,915 | 196 | 1,380,683 | 1,694 | 14,581,641 | 612 | 4,163,640 |
| Accessories and parts (carburetors) | | 436,108 | | 258,390 | | 1,862,215 | | 1,106,998 |
| **IMPORTS** | | | | | | | | |
| Automobiles (dutiable) | 45 | 51,743 | 38 | 31,334 | 245 | 271,221 | 203 | 153,732 |



Acme

### New Viaduct

**Adding to the maze of traffic aids about New York City is this new viaduct at Highbridge Park, connecting the Harlem River Drive (left) with the new Trans-Manhattan tunnel approach to the George Washington Bridge. The tunnel, 2400 ft. long, is the first crosstown highway designed to take traffic off New York City's streets.**

## U.S. Rubber Develops Rubber Armor Plate

Experiments conducted for three years by the United States Rubber Co. have developed an airplane armor plate of rubber and steel superior to and much lighter than the type now in use, F. B. Davis, Jr., president of the company, has announced.

Old steam-pipe tunnels under the plant were converted into firing ranges, Davis said, and tests revealed the rubber-and-steel combination superior in bullet-penetration resistance to steel armor plate of 20 per cent greater weight.

Keeping secret the formula and construction details, Davis declared that the plant was prepared to produce the armor in quantity if supplied with steel plate.

He pointed out that the weight saving brought about by use of rubber could enable makers of military planes to provide greater armament, wider armored areas, more speed, greater maneuverability or greater cruising radius.

### Automotive Industries

***Summary of Automotive Production Activity***

**BUSES** A few additional inquiries from industrial centers indicate need for additional equipment to handle increased employment in those areas where national defense buying is stimulating business.

**TRUCKS** Except for levelling off here and there most makers report continued high production schedules for this season of the year. Deliveries continue well above same period last year.

**TRACTORS** Threatened drought in some sections has had some effect on sales and some makers have reduced production schedules. Highway and airport activities continue to take considerable part of factory output.

**AUTOMOBILES** All but four leading producers closed second week of July for annual changeover to new models. Early estimates indicate July output may not greatly exceed production of July, 1939. First half of July output estimated at 116,500 cars and trucks.

**MARINE ENGINES** Production of heavier models, particularly Diesels, reported as forging ahead from month to month. Some report conditions "very satisfactory" while other makers state they are facing seasonal slump. Builders of powerplants for army and navy use report considerable backlogs.

**AIRCRAFT ENGINES** With backlogs of aircraft estimated at well above a half-billion dollars, and orders for engines continuing to come, all engine plants that are in production are increasing output schedules.

*This summary is based on confidential information of current actual production rates from leading producers in each field covered. Staff members in Detroit, Chicago, New York and Philadelphia collect the basic information, in all cases from official factory sources.*



# Ourselves & Government

***A Check List of Federal Action Corrected to July 9***

### FEDERAL TRADE COMMISSION

TRADE PRACTICE RULES—Reported that, despite strong opposition in trade, Commission is preparing to issue final automobile trade practice rules. (See page 84.)

VS. GENERAL MOTORS CORP.—Respondents filed a brief with the FTC on July 5, in which they answer the Commission's complaint in the so-called exclusive dealer case that General Motors dealers are required to handle GM parts to the exclusion of all others. (See page 87.)

F.O.B. PRICE CASE—Trial examiner's report next development expected in the Ford case. Testimony closed in GM case, after respondent waived oral argument. Trial examiner's report, commission brief and respondent's reply brief all filed.

## Defense Licensing

(*Continued from page* 83)

lamation the licensing system brings under export control metal-working machinery for (1) melting or casting; (2) pressing into forms; (3) cutting or grinding, power driven; and (4) welding machines. This includes virtually all machine tools, exports of which have mounted sharply since 1938 due to war demands while at the same time the industry is faced with an enormous domestic national defense program.

The original $200,000,000 machine tool purchase program is expected to be increased greatly by growing national defense appropriations and authorizations. Though already operating at top speed the industry, it is said, will be called upon to further expand

(*Top of next column*)

### Now Capital

**It is reported that Homer Martin, former president of the AFL division of the UAW, and John Gillespie, Detroit politician once active in settlement of labor disputes involving Ford Motor Co., have formed a partnership to sell parts and materials to automobile manufacturers.**

**Martin told reporters that he was "enjoying business immensely," and added he was glad he retired last April 26 from the presidency of the UAW-AFL. He reported "business is good." Asked what products the firm sold, Martin replied, "All kinds of products. We are jobbers."**

production, a situation that is complicated by a shortage of skilled mechanics. Export control in view of this condition long had been expected. Reflecting the sharp rise in American exports of machine tools is the fact that total exports in the first five months of 1940, aggregating $73,400,410, were little more than a $1,000,000 short of similar exports in the entire year 1938, amounting to $74,670,338, and only $20,000,000 less than in 1939, a year of heavy foreign shipments. The chief consuming countries have been England, France, Russia and Japan.

## United Specialties Reports on Profits

United Specialties Co. reports a net profit of $198,996.14 for the nine-month period ended May 31. For the same period last year the company showed a net profit of $80,860.69.

# MEN

(*Continued from page* 83)

**C. W. Avery,** president and chairman of the board, Murray Corp. of America, has been elected president of the Detroit board of commerce.

**C. S. Gross** has been elected president of Vega Airplane Co. Since 1933 he has been sales executive in charge of Lockheed's New York offices.

Norton Co. has announced the election of **H. K. Clark** to the office of vice-president and general manager, and **A. B. Holmstrom** to the office of vice-president and works manager.

**E. G. Hefter,** recently in charge of metropolitan sales promotion for Stewart-Warner Corp., has been appointed general sales manager for Ero Manufacturing Co.

**L. M. Clement** has been appointed manager of the engineering division of The Crosley Corp.

The Civil Aeronautics Authority has announced the appointment of **Jerome Lederer** as director of the new Safety Bureau which on July 1 took over the functions of the Air Safety Board.

**H. S. Johnson** has been appointed vice-president and general manager of The Metal Specialty Co. Most recently he has been on special assignment work with a firm of management engineers.

**J. E. Bayne** has been promoted to the position of general sales manager, Plymouth division of Chrysler Corp. He was formerly assistant sales manager under **L. D. Cosart** who has left Plymouth to take up new duties with the Dodge division of Chrysler Corp.

**John Haien,** director of youth training of Chrysler Corp. has been appointed by the National Youth Administration to direct the training of 100,000 young men for industry in the National Defense Program.

**L. L. York** has joined the aircraft engine division of Continental Motors Corp. as sales and service engineer.

Driver-Harris Co. at its recent meeting elected the following officers: **F. L. Driver,** president; **S. M. Tracy,** executive vice-president and treasurer; **J. Drennan,** vice-president in charge of foreign subsidiaries; **F. V. Lindsey,** vice-president in charge of sales; **H. D. McKinney,** vice-president in charge of manufacturing operations; **E. A. Harleman,** secretary and assistant treasurer; **M. W. Clark,** assistant secretary.

**J. H. Alses** has been named chief inspector of the Oldsmobile division of General Motors, succeeding **K. C. Plasterer,** who will handle special assignments. Alses has been connected with the automobile industry for 21 years, holding positions with the Mercer Automobile Co. and the White Motor Co. before joining Oldsmobile in 1925. He was production engineer at the time of his promotion.

**Thomas R. Lippard** has been elected president and general manager of the Federal Motor Truck Co. Mr. Lippard joined Federal last fall as vice-president in charge of sales and engineering. He has also been elected to the board of directors.

## Wartime Tax on Canadian Cars

Automobiles in Canada will bear a wartime tax load "virtually prohibitive" on higher priced models and decreasing gradually on lower priced cars, under the budget changes announced in Ottowa, Ont.

On all new, unused passenger cars valued by the manufacturer up to $700, the new excise will be 10 per cent. On the excess over $700 and up to $900, 20 per cent; on the excess over $900 and up to $1,200, 40 per cent; on the excess over $1,200, 80 per cent. The excise tax on automobiles at present is five per cent on the value in excess of $650.

The war revenue tax on tires and tubes for automotive vehicles of all kinds has been raised to five cents a pound. The old rate was two cents a pound for tires and three cents for tubes. The tire and tube tax, however, will not be applied to tubes and tires forming part of the original equipment of new vehicles. Estimated new revenue is $1,100,000 a year.

The excise tax on automobiles applies to the total manufacturers' price charged, including all charges for accessories, optional equipment, servicing, financing, warranty or any other charge "contracted for at the time of sale, whether charged for separately or not, but not to include heaters or radios."

The tax is to apply to all cars "in transit to dealers or others."

## Kennametal Firm Is Planned for Canada

George H. Alexander Machinery Ltd., of Birmingham, England, in conjunction with Philip M. McKenna of McKenna Metals Co., Latrobe, Pa., have organized Kennametal of Canada, Ltd., for manufacturing Kennametal, the new steel-cutting carbide, for Canada and the British Dominions. The main office and factory of Kennametal of Canada, Ltd., will be in Hamilton, Ontario. Mr. McKenna is president of the firm, and Arthur H. Alexander of Victoria, British Columbia, has been named general manager. Mr. Alexander is a member of the firm of George H. Alexander Machinery, Ltd., manufacturers and importers of machinery and equipment, operating several plants in England. He has been in the United States for several months purchasing equipment for the Hamilton factory.

## New Hercules Diesel For Ford Replacement

A larger Diesel in "Power Package" form for replacement use in Ford Trucks, corresponding in performance to the V-8 95-hp. gasoline engine is now available, according to a statement issued by Hercules Motors Corp. This larger displacement engine (255 cu. in.) is the Model DOOD four-cylinder 4¼ in. x 4½ in.—developing 178 foot pounds of torque at 1400 r.p.m. and maintaining a high torque output over a wide range of engine speeds, with a horsepower peak of 79 at 2600 r.p.m.

## Murray Corp. Reports Nine Month Profits

The Murray Corp. of America report on profits for the nine months ended May 31, 1940, indicated a net profit of $983,583.45. Gross profit from sales amounted to $2,473,389.89 in this period.

## Centralization

(*Continued from page* 81)

buying for the Government. While the agency attained a fair degree of success there were certain government departments which, for various reasons, continued to do their own buying. Hence, while the objective was to attain greater centralization, actually the procurement division was until recently engaged in the process of de-centralizing much of the Government's non-military purchasing.

## Packard Adjusts '40 Model Prices

Packard Motor Car Co. released a price list for its 1940 models which showed advances ranging between four and six dollars on its lower priced models, and up to $14 on its highest priced line. It was stated that the new prices reflect the increases in Federal excise taxes which became effective July 1.

## MEMA Index Reveals 1940 Business Rise

The grand index of the Motor and Equipment Manufacturers Association dropped from 170 to 157 (January, 1925, equaling 100) from April of this year through May. However, May, 1940, index showed a 29-point increase over the same month last year. Original equipment shipments to vehicle manufacturers, at 162 for May this year, was 62 points above last May. The MEMA index of car and production for May was set at 171, that of May last year was at 130.

## PUBLICATIONS

A new bulletin by the Mine Safety Appliances Co. describes its **all-service gas mask.***

Karpex Manufacturing Co. has published a folder describing its new **rubber bumper mats.***

Ted Nagle Equipment Corp. has released a catalog on its line of **automotive and radio test equipment.***

A new **handbook and data bulletin on fluorescent lighting** has been prepared by Benjamin Electric Mfg. Co.

Yankee Metal Products Corp. has issued a catalog covering its complete line of **lights, signals, mirrors, reflectors and other safety devices.***

The Bureau of Foreign and Domestic Commerce has published the 1940 edition of "Market Research Sources," a guide to information on **domestic marketing.** Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, at a price of 25 cents.

Circular No. 32 of American Foundry Equipment Co. describes the new American High Efficiency Cycline **Dust Collector.***

Johnson Bronze Co. has issued a catalog on its **bearing bronze.***

A booklet titled **"Highway Users Pay Their Way and More,"** material from the Eastman report on public aids to transportation, has been published by the National Highway Users Conference.*

Michel Export Co. has printed a pamphlet discussing its Alframine **detergent.***

Catalog No. 1845 by Link-Belt Co. describes the company's complete line of **flexible couplings.***

Technical bulletin No. 1372 by Valvoline Oil Co. covers the **development, characteristics and applications of an all-season all-purpose gear lubricant** and also material on the **solution of the hypoid gear lubrication problem.***

A booklet on its **Diesel engines** covering power units, generator sets and marine engines has been released by Caterpillar Tractor Co.*

Ex-Cell-O Corp. has published an illustrated booklet titled **"Problems Solved by Broaching".***

An **electrical connector guide** has been published by Burndy Engineering Co., Inc.*

A folder by Diesel Equipment Corp. covers its **fuel injectors.***

Handy & Harman has released a folder descriptive of its Sil-Fos and Easy-Flo **brazing alloys.***

Moraine Products division, General Motors Corp. announces the publication of its new **Durex Bearing Tool List.***

Westinghouse Electric and Manufacturing Co. has published a booklet covering the complete line of Westinghouse **air and compressed air circuit breakers.***

Pratt & Whitney has issued two new circulars, one covering the P&W **Electrolimit Paper Gauge** and the other on the **Pilot Cylindrical Plug Gage.***

Waukesha Motor Co. has published a pamphlet on its **multi-fuel engines.***

General Malleable Corp. has issued a folder discussing the solution of **annealing** problems.*

* Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

# Coordination by Wire

(*Continued from page 54*)

private line teletype system, with stations located at the engineering laboratory in Dearborn, the production department and the driveaway office in the Rouge plant and the parts warehouse at Highland Park.

Ford maintains a schedule of daily connections between its TWX stations, ranging from six to nine connections a day, depending upon the volume of traffic. The main office at Dearborn is open from 7:30 a. m. to 10 p. m., five days a week, while one operator is on duty Saturdays. There are 28 teletype machines in the Dearborn office, six of which are commercial telegraph company machines. To expedite traffic, Ford utilizes a 60-page code book which saves time and transmission charges.

Chrysler Corporation began the installation of a teletypewriter communication system in 1932. The Communications Department headquarters are located in the Chrysler plant at Highland Park, Detroit suburb, and operates under R. P. Fohey, corporation secretary. Miss Rose Heffernan is in charge of the system.

The first teletype connection was between Highland Park and the parts depot at Philadelphia, and then this was gradually expanded into the present system. Chrysler maintains Bell System TWX service between Highland Park, Plymouth assembly plants at Evansville, Ind., and Los Angeles, a parts plant at Newcastle, Ind., and the Pekin Wood Products Company, a Chrysler subsidiary at West Helena, Ark. A daily schedule of six to a doxen connections between these points and Highland Park is maintained.

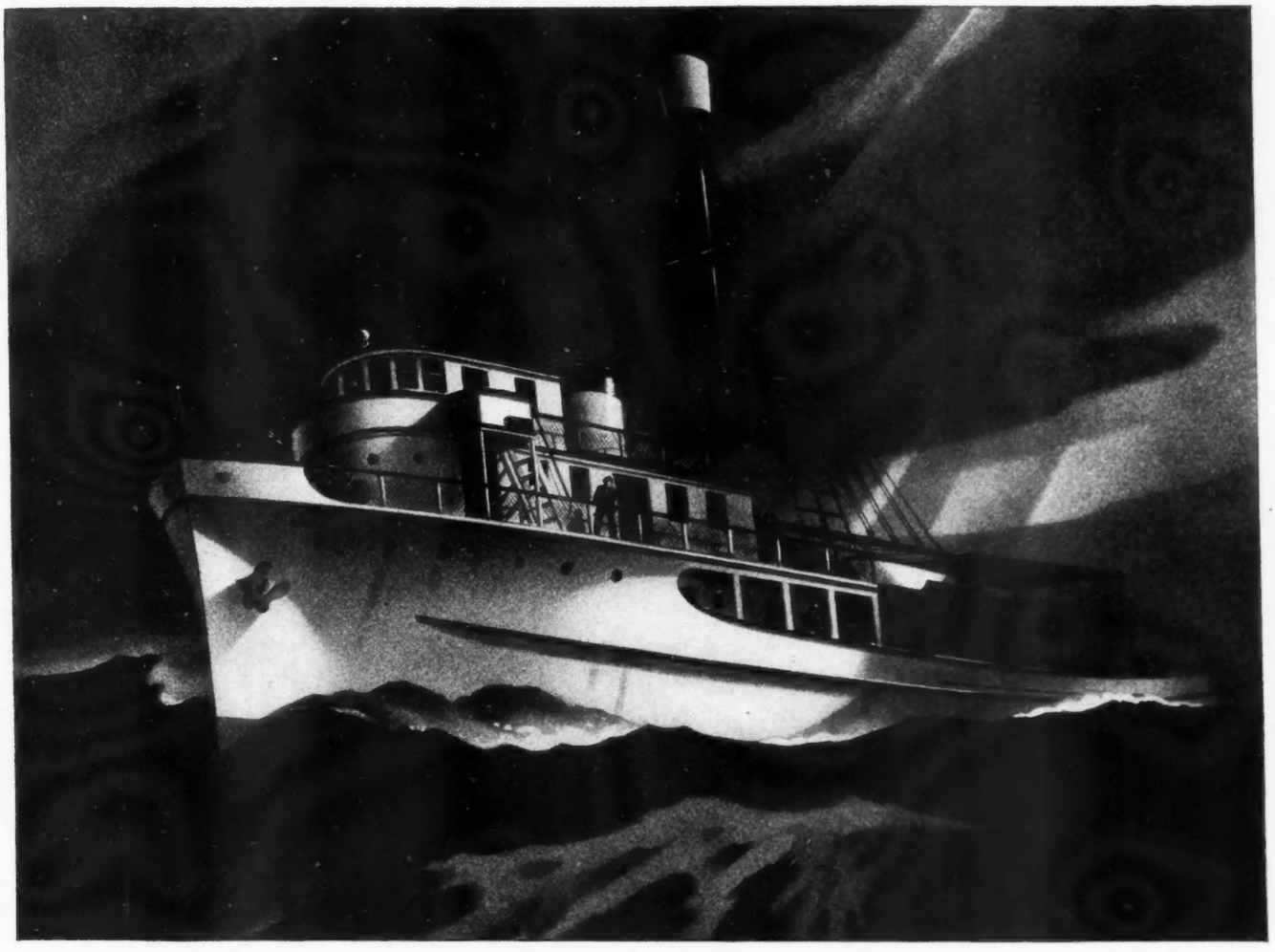
Eight Chrysler Corporation parts depots are connected up by TWX service and relay their messages for Detroit plants through the Chrysler Parts Division at Marysville, Mich., 50 miles north of Detroit. The parts depots on this circuit are the master depots at Philadelphia and Kansas City and the smaller warehouses at Atlanta, Boston, Chicago, Dallas, New York City, Philadelphia, and San Leandro, Cal. Communication between Highland Park and Marysville is maintained by two private line teletype circuits. There also is a separate TWX set-up between the Chrysler export division at Highland Park and its New York office.

Regional offices of the corporation located in cities where there are parts depots also use the TWX service from those points to communicate with the corporation offices at Highland Park. They telephone their messages to the parts depots, from whence the communication goes by teletype to Marysville and thence by private line teletype to Highland Park.

As most of Chrysler's manufacturing operations are centered in the Detroit area, there is another inter-plant system of 11 teletype stations which clears any messages to Marysville or outside points through Highland Park. The Detroit stations are located as follows: three at Dodge Main, two at Chrysler-Jefferson, and one each at DeSoto, Dodge Truck, Plymouth and the Chrysler Canadian plant in Windsor, Ont., and two at the Canadian customs at East Windsor, Ont.

The two machines at the customs office permit the quick clearance of corporation trucks carrying parts and supplies between the Detroit plants and the Canadian factory. The customs invoice of goods is sent by teletype as soon as the truck leaves the Detroit plant. While the truck is enroute across the Detroit River by ferry, the employes in the Chrysler customs office across from the Canadian customs in East Windsor check the teletyped invoice and compute duties. Then, when the truck leaves the ferry in Canada, it is halted only momentarily, eliminating any costly delay of trucks, men or materials.

The Chrysler communication system operates five days a week, from 8:30 a. m. to 5:30 p. m. There are five em-



# 4140 GOES TO SEA

It is well for all concerned that builders of marine Diesels make performance capacity the primary basis for the selection of materials. Breakdowns at sea or anywhere else are no fun for anyone, including the engine builder.

But the demand for reliability can be met and production costs still kept where they should be. One prominent builder, for example, is doing both by specifying Chromium-Molybdenum (SAE 4140) steel for a number of parts including bolts, wrist-pins, cylinder head studs, gears, tappets and crankshafts.

The fact that this steel can be treated to develop the properties necessary for applications having such different requirements is of value to both builder and user. It simplifies heat treatment and stockroom procedures. And, since simplification makes for uniform quality in the finished parts, it gives added assurance of dependability.

Your own product might benefit through the use of this versatile steel. You will find complete data on this and other molybdenum steels in our book "Molybdenum in Steel," which will be sent free on request.

PRODUCERS OF MOLYBDENUM BRIQUETTES, FERRO-MOLYBDENUM, AND CALCIUM MOLYBDATE

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ployes in the central office — three operators, a messenger girl and a telephone girl. The system handles 13,000 to 15,000 messages per month. The parts division at Marysville has three operators who handle the parts message traffic. Because the volume of traffic is not so heavy at the parts depots and the teletype stations in the plants, the operators at those points are on a part-time basis, having other duties during the time when their station is not in communication with Marysville or Highland Park as per schedule. Chrysler employs both men and women as operators.

In addition to four Bell System teletypewriter machines at Highland Park, there are four telegraph company machines for supplementary messages to points outside the Chrysler inter-plant system.

Other automotive users of private communication systems include Packard Motor Car Company, which has an inter-plant network of 25 teletype machines at Detroit for coordinating production activities as well as TWX service to its larger distributors throughout the United States.

Nash Motor division of Nash-Kelvinator Corporation employs teletype service to handle communications between its Detroit, Grand Rapids and Kenosha, Wis., plants and several sales branches.

International Truck division of International Harvester Company has a private line teletypewriter network tying together its plants and general offices located in the Chicago area and its Indiana plants located in Indianapolis and Fort Wayne. A pneumatic tube system for pick-up and delivery of messages to various parts of the general offices at Chicago is maintained.

Most of the teletypewriter equipment in the automobile plants, as well as private wires, are leased from the telephone companies, which look after all maintenance and repair work.



## Ford Receives High Engineering Award

Henry Ford on June 25 received what is regarded as the highest honor that can be conferred upon a mechanical engineer — the James Watt International Medal. It has been awarded to only two men, and Mr. Ford is the only living holder of it.

The medal is given by the Institution of Mechanical Engineers, a British society which cooperates with engineering groups in the 17 industrial nations of the world. The first medal was given to the late Sir John Aspinall in 1936 on the 200th anniversary of James Watt's birth. Others are to be awarded biennually.

The award was presented to Mr. Ford by Alex Dow, former president of the Detroit Edison Co., at a dinner in Detroit.

## CALENDAR

### Conventions and Meetings

SAE West Coast Transp. & Maintenance Meeting, Seattle .....Aug. 16-17
National Industrial Advertisers Association, Annual Meeting, Detroit, Sept. 18-20
SAE National Tractor Meeting, Milwaukee .....Sept. 24-25
SAE Annual Dinner, New York.....Oct. 14
American Society for Metals, Annual Meeting, Cleveland, Ohio....Oct. 21-25
American Welding Society, Annual Meeting, Cleveland .....Oct. 20-25
SAE Nat'l Aircraft Production Meeting, Los Angeles .....Oct. 31-Nov. 2
Aeronautical Chamber of Commerce of America, Inc., Annual Meeting, New York .....Dec. 5
National Association of Manufacturers, Annual Meeting, New York...Dec. 9-13
SAE Annual Meeting, Detroit, Jan. 6-10, 1941
National Automobile Dealers Association, Convention, Pittsburgh, Pa. Jan. 20-23, 1941

### Shows at Home and Abroad

National Automobile Show, Grand Central Palace, New York .....Oct. 12-19
Detroit Automobile Show .....Oct. 12-19
Pittsburgh Automobile Show.....Oct. 19-26
National Metal Congress & Exposition. Cleveland, O. .....Oct. 21-25
Chicago Automobile Show....Oct. 26-Nov. 3
Automotive Service Industries Show, Chicago .....Dec. 9-14
Machine & Tool Progress Exhibition, Detroit .....Mar. 24-29, 1941